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KØBENHAVN
C. A. REITZEL, BOGHANDEL
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1922

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ON THE DENSITY OF THE YOUNG PLAICE POPULATION IN THE EASTERN PART OF THE NORTH SEA AND THE SKAGERAK IN PRE WAR AND IN POST WAR YEARS

BY

DR. A. C. JOHANSEN

KØBENHAVN
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BIANCO LUNOS BOGTRYKKERI
1922

CONTENTS.

I. Introduction 3
II. Investigations in the North Sea 6
III. Investigations in the Skagerak and northern Kattegat 16
VI. On the value of the systematic fishing experiments as a means of showing variations in the frequency of Young Plaice 21
V. Concluding remarks about the results of the investigations 22
Dansk Resumé 23

I. Introduction.

From investigations made in Denmark, Holland, England and Germany during or after the great war, it has been ascertained that the composition of the stock of plaice in the North Sea was highly altered as a consequence of the restriction on fishing during the war. The medium and large plaice became much more dominating in the catches than in the later pre war years, and according to the German investigations by Mielck[1] the number of pelagic plaice eggs increased very much in the southern part of the North Sea. Considering these facts it seemed desirable to investigate whether or not an increase in the density of the young plaice population can be traced in recent years in the North Sea and the Skagerak.

The material available in Denmark which would afford information concerning this question, may be divided into three different groups. Firstly it consists of statistics of the total Danish catch on the Plaice Grounds in the eastern part of the North Sea, the Skagerak and the north-western Kattegat. Secondly of statistics about average catch per fishing unit from Danish cutters or Danish motor boats in part of the same areas, and finally of the results of systematic fishing experiments, which have been carried out for a series of years.

The systematic fishing experiments have in the main been carried out on quite shallow water along the Danish coasts by a so-called Young Plaice Trawl. During the years 1907—1913 and from 1920 and onwards this plaice trawl has been of a uniform size and construction, the dimensions of it being as follows:

Otter boards: 80 cm × 37 cm.[2]
Foot rope: 7 m.
Head line: 6 m.
Total length of Trawl: 9 m.
Size of meshes in wings and belly: 10 mm (one side of meshes).
— - — - cod-end: 7 - (- - - —).

This small apparatus has been used from a motor-boat of 3—5 tons gross tonnage very near the coast, generally in depths of from 1 to 3 meters, where the plaice of the 0-Gr. occur with the greatest frequency at the time of the year when the fishing experiments are mainly carried out, viz. in the months July, August and September. At the same depths and times the plaice of the I-Gr. are also rather numerously represented in most areas.

The Young Plaice Trawl can only be employed in calm weather and it is used normally in places with clean sandy bottom where there is no or very little vegetation of Algae or Zostera.

The duration of the hauls was most frequently 30 minutes, and the haul in one hour is taken as a fishing unit. The speed has been from 1 to 1.5 miles per hour.

[1] Annalen der Hydrographie etc. XXXXIX. Jahrg. (1921), Heft III.

[2] In 1905 and 1906 a somewhat smaller gear of the following dimensions was used: Foot rope: 5 m. Head line: 4.7 m. Total length: 7 m. — The figures for "catch per hour" for these years are multiplied by 1.5 to be comparable with those for later years.

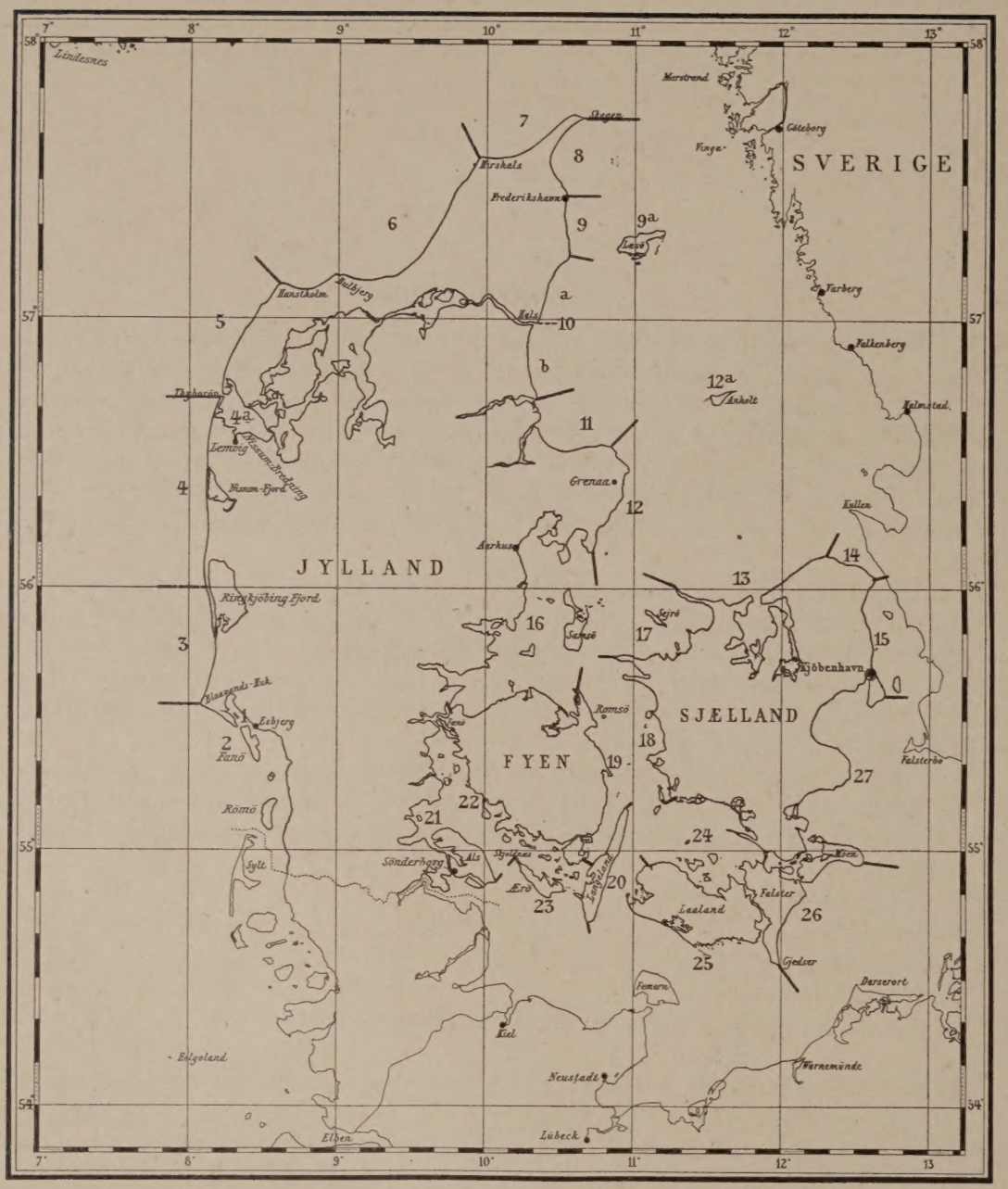

Fig. 1. The Danish coastal areas No. 1—27.

In order to compare the number of plaice of the 0-Gr. or I-Gr. caught per hour with young plaice-trawl in various years, we have made charts in which each station is entered with the number of plaice caught per hour, and also tables which give the average catch for all stations in certain coastal areas. These areas are shown on Fig. 1. It should be remembered that the outer limit for the areas lies very near the coasts, at a depth of about 3 meters. It has been the aim that the various areas should have a natural limitation. Within each of the areas there is no great difference with regard to the mean salinity of the surface water (compare Fig. 2).

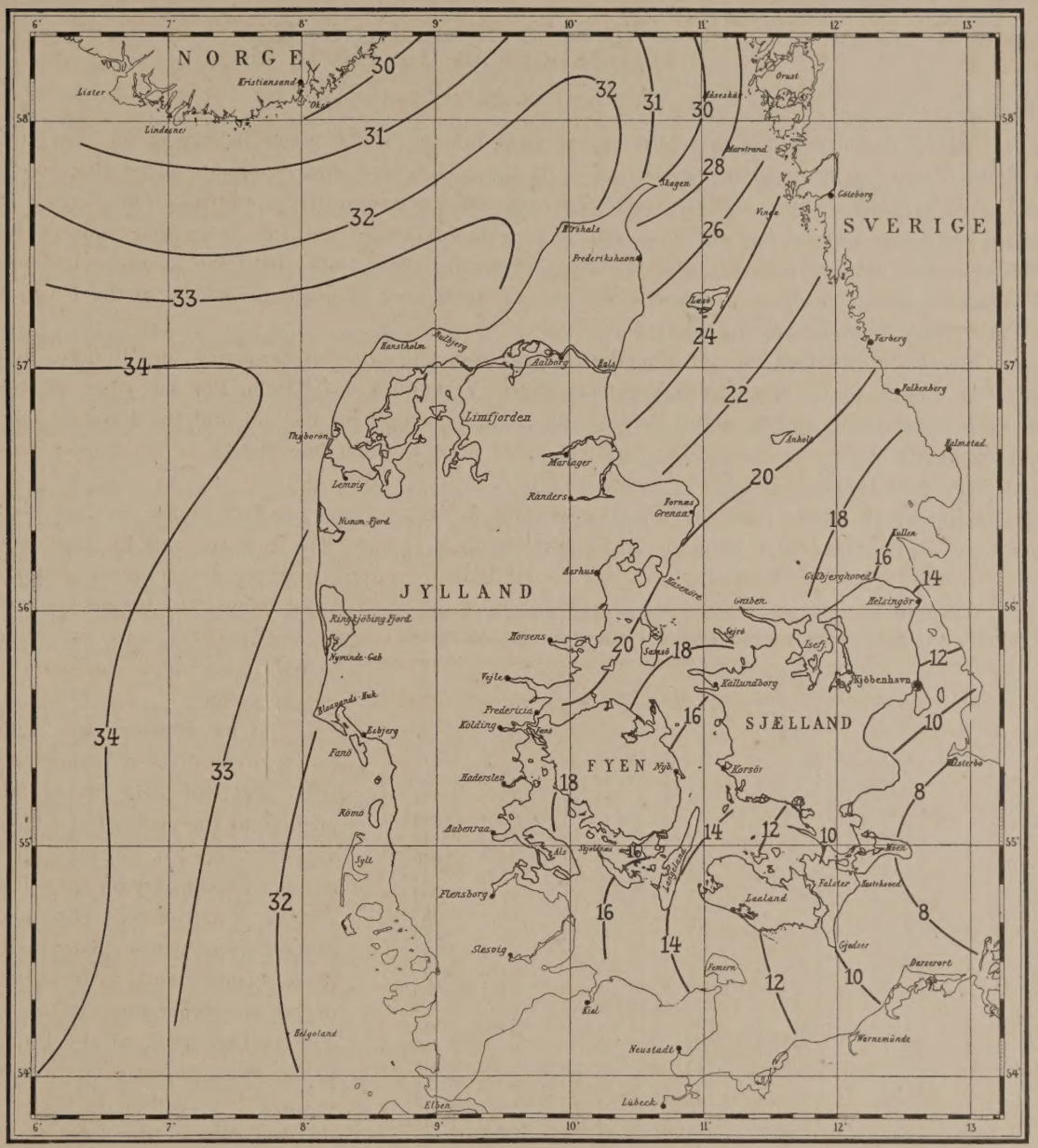

Fig. 2. Mean Salinity of the Surface Waters. Kattegat and Belts after J. P. Jacobsen. North Sea and Skagerak after Martin Knudsen and Kirstine Smith.

In these systematical fishing experiments carried out in connection with age determinations of the fishes (by investigations of the otoliths), we have noticed that the young plaice do not occur, even approximately, with the same frequency in the same areas during different years. For each of the areas investigated we have found that proportionately large amounts of fry occur in certain years and proportionately small amounts of fry in other years.

II. Investigations in the North Sea.

Total Yield of the Plaice Fishery.

Table 1 contains a survey of the yearly yield in tons of the plaice fishery in the years 1892—1920 from the five countries: Denmark, Germany, Holland, England and Scotland. More than 95 % of the yield of the plaice fishery in the North Sea originate from these five countries. The Belgian capture is also of some importance, but we have not been able to obtain statistics from that country for such a long series of years as for the other countries. For the years 1904—1912 the average yield per year of the Belgian plaice fishery in the North Sea was ca. 1200 tons. The plaice fishery in the North Sea from Norway and France is quite insignificant.

The Table is based on the official statistics from the different countries, on "Bulletin Statistique", and on a treatise of Dr. KYLE in Rapports et Procès-Verbaux Vol. III 1905. For the years 1892—1902 the statistics for England and Scotland include also plaice captured at Iceland and the Faroes. The yield of plaice from these areas was, in the year 1903, from 5000 to 6000 tons, but it is not known whether the years 1892—1902 gave a greater or a smaller yield.

It is a well known fact that the Danish and the Dutch plaice fishery in the North Sea takes place mainly on the Small Plaice Grounds inside the 30 meter curve. The German and English fishery takes place to a considerable extent both on the Small Plaice Grounds and on deeper water or far from the coast, where the bigger and older plaice especially occur, and the Scotch plaice fishery takes place almost entirely on deeper water.

Table 1. Yield in Tons of the Plaice Fishery in the North Sea.

Year	Denmark	Germany	Holland	England	Scotland	Total
1892	964	2.688	6.243	31.544	2.864	44.303
1893	1.515	4.070	6.941	38.542	3.158	54.226
1894	1.514	4.065	6.599	39.311	3.404	54.893
1895	679	2.945	5.352	34.054	3.331	46.361
1896	1.412	3.453	4.466	32.312	3.396	45.039
1897	1.489	2.957	5.519	33.503	2.853	46.321
1898	1.182	2.638	5.528	32.049	3.020	44.417
1899	2.170	3.305	5.748	35.159	4.161	50.543
1900	2.316	2.567	5.856	35.579	4.690	51.008
1901	2.566	3.003	7.225	40.205	5 703	58.702
1902	4.381	3.760	9.256	61.600	4.919	83.916
1903	2.402	2.770	5.579	48.717	5.183	64.651
1904	3.495	2.658	7.024	40.657	3.013	56.847
1905	3.930	2.773	8.095	39.918	2.113	56.829
1906	3.020	2.141	7.555	29.073	2.284	44.073
1907	4.592	2.221	8.764	33.071	2.255	50.903
1908	3.030	2.615	7.638	31.028	1.933	46.244
1909	3.856	2.762	8.878	30 090	2.446	48.032
1910	5.289	2.730	10.394	25.792	1.916	46.121
1911	5.312	2.378	12.301	27.280	2.027	49.298
1912	9.080	2.475	9.947	26.918	1.834	50.254
1913	9.206	3.027	9.965	24.651	1.638	48.487
1914	6.044	2.488	9.439	20.509	2.471	40.951
1915	9.820	1.328	7.809	6.460	1.423	26.840
1916	5.778	2.684	9.364	4.832	1.757	24.415
1917	2.184	4.384	11.922	3.985	1.529	24.004
1918	2.897	8.413	11.845	14.514	1.429	39.098
1919	5.275	6.204	11.424	24.692	2.390	49.985
1920	3.887	4.409	7.325	33.422	3.390	52.433

If we consider the yield for the different countries it is obvious that the great yield of 1919 and 1920 in proportion to the yield of the later pre war years (1910—13) do not fall to those nations which carry on the fishery chiefly on the Small Plaice Grounds, but to those nations whose plaice fishery takes place predominantly or to a very essential degree on deeper water in the North Sea. The average yield of the Danish plaice fishery was considerably smaller in the years 1919—20 than in 1910—13. Thus the statistics of the total yield do not suggest that the amount of young plaice in the North Sea should have increased in consequence of the war protection. The statistics do not either afford any proof for the opposite belief, because there are special reasons known for the proportionately low yield of the fishery on the Small Plaice Grounds in 1919 and 1920, at any rate with regard to the Danish fishery. In the first instance we must call attention to the fact that, from 1916 and onwards, a considerable number of the Danish cutters began to carry on haddock fishery instead of plaice fishery with seine (snurrevaad). Secondly we may mention that the most important Danish

market abroad for plaice, viz. Germany failed on account of the collapse of the German finance.[1] The Danish plaice fishery in the eastern part of the North Sea has for this reason been carried on less intensively during the years since the war than in the years before the war.

The statistics in Table 1 concerning the yield of the plaice fishery in the North Sea from the different nations call forth a few more remarks. They show that the yield of the Danish fishery in-

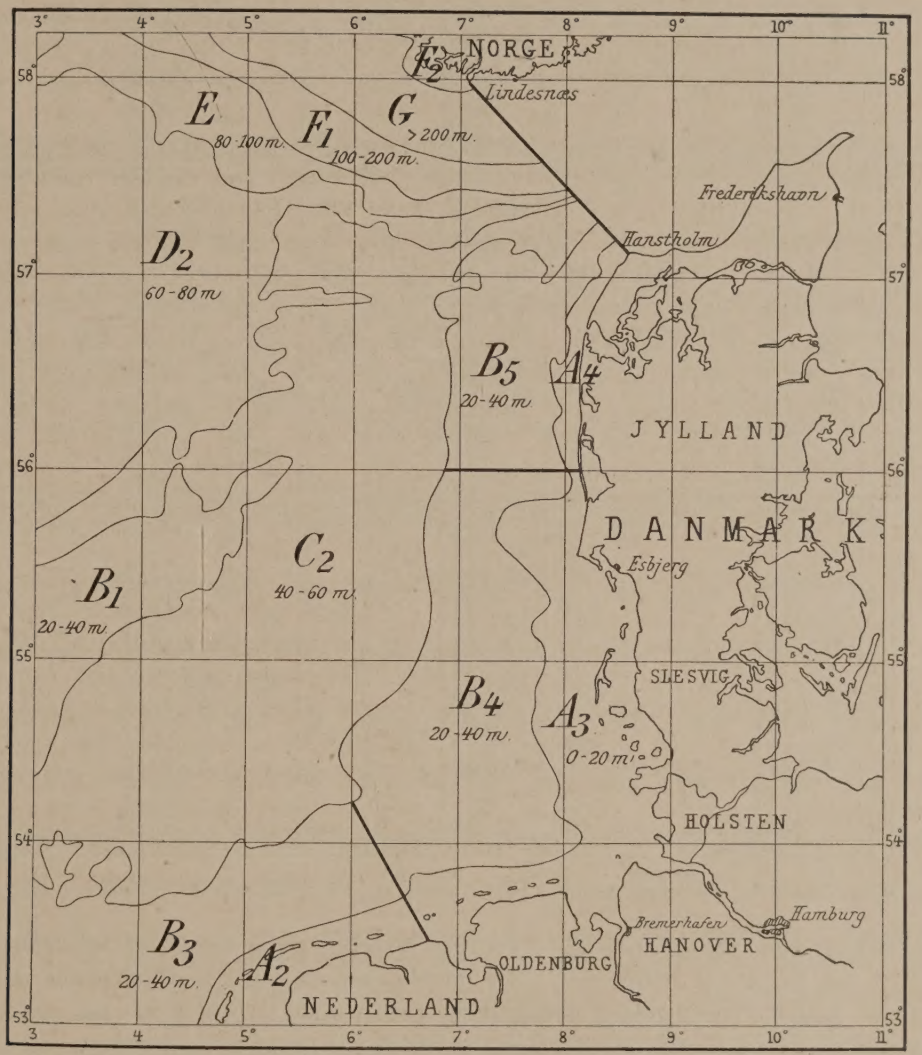

Fig. 3. The Depth Areas.

creased highly from 1892 to 1913, and that the yield of the Dutch fishery increased rather gradually during the period 1892 to 1911. With regard to Germany the yield was for the period 1892 to 1902 somewhat higher than for the period 1903—1913, but this may, perhaps, be ascribed to the fact that the statistics in the first named period also comprise some plaice captured at Iceland and in the Skagerak. If we consider the yield from England and Scotland we see another picture. Firstly we notice a significant in-

[1] The same fact has caused an increasing number of Danish fishermen of later years to go to England in order to carry on the seine fishery from English harbours.

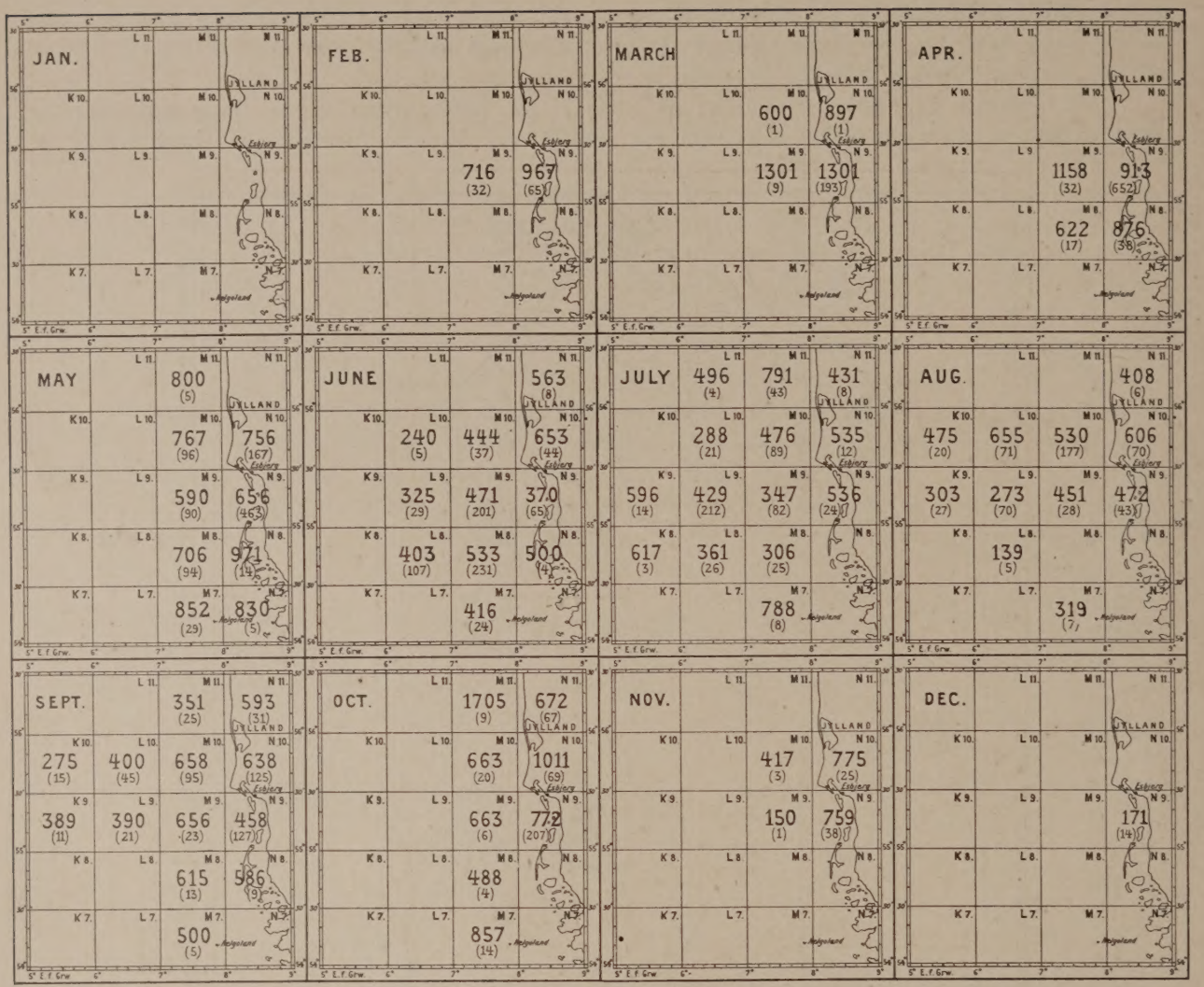

Fig. 4. Average catch of Plaice in Kgs. per fishing day of Danish cutters in each month of 1913 (number of fishing days in brackets).

crease in the yield during the period 1892—1901-02 followed by a very high decrease in the yield from 1902—03 to the beginning of the war. This fact suggests that the stock of plaice on the off shore grounds, on which England and Scotland essentially base their fishery, have shown less power of resistance against the intense fishery than the stock on the Small Plaice Grounds, which form the main basis for the Dutch and the Danish fishery. This feature may be explained by the fact, that the stock of large and medium plaice is less quickly renewed by growth than the stock of small plaice in the coast belt.

Average catch per fishing unit.

For four years before the great war and one year after the war we have statistical information of the average catch per fishing day of the cutters fishing from Esbjerg on the Small Plaice Grounds in the eastern North Sea. It will be of interest here to compare the results for those five years, especially in the Areas A_3 and B_4, where the small plaice are most predominating. The five years for which information about catch per fishing day is at hand are 1909, 1910, 1911, 1913 and 1919. The statistics for these years are given below.

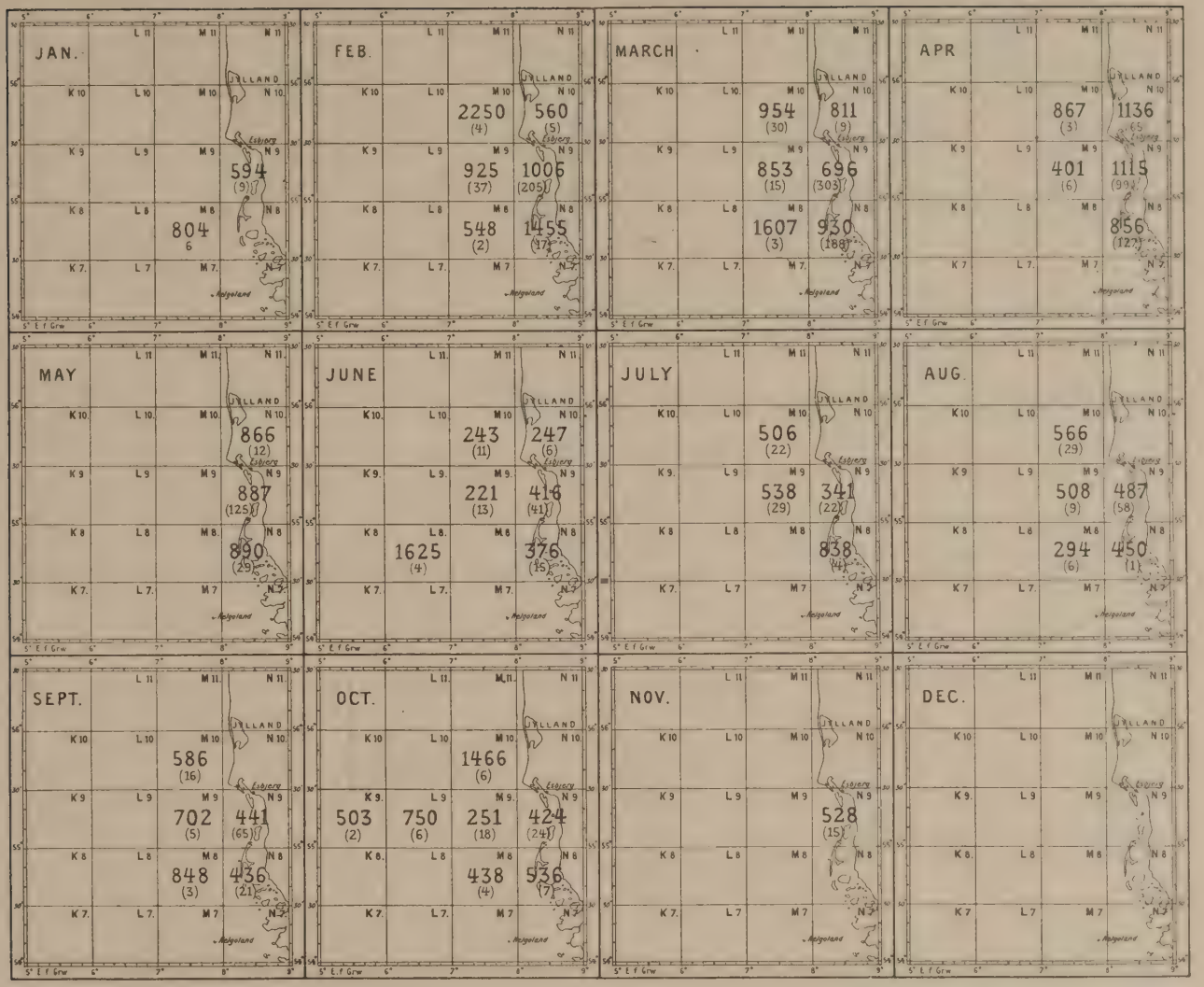

Fig. 5. Average catch of Plaice in Kgs. per fishing day by Danish cutters in each month of 1919 (number of fishing days in brackets).

Table 2. The Danish Cutters' Average Catch of Plaice per Fishing Day in various Areas of the North Sea.

	Catch in Kilograms						Number of Fishing days					
	A_3	B_4	A_4	B_5	C_2	Total	A_3	B_4	A_4	B_5	C_2	Total
1909.....	775	579	531	286	238	522	681	2078	29	903	271	3962
1910.....	756	455	507	161	160	572	4315	2004	124	1084	253	7780
1911.....	695	505	208	184	393	568	3479	1815	486	127	590	6497
1913.....	788	335	575	780	398	635	2963	1188	84	116	460	4811
1909—13...	747	484	315	245	330	576	11438	7085	723	2230	1574	23050
1919.....	818	543	..	..	(817)	785	1527	211	0	0	18	1756
Increase % from 1909—13 to 1919	9.5	12.2	..	..	147.6	36.3	..	..	..	..	..	..

This Table shows that there is on the whole an increase in the catch in kg per fishing day from the period 1909—13 to 1919. This increase, however, is not great on the Small Plaice Grounds. For A_3 it amounts only to 9.5 %, and for B_4 to 12.2 %. In the period from 1904—06 to 1919 and for the areas

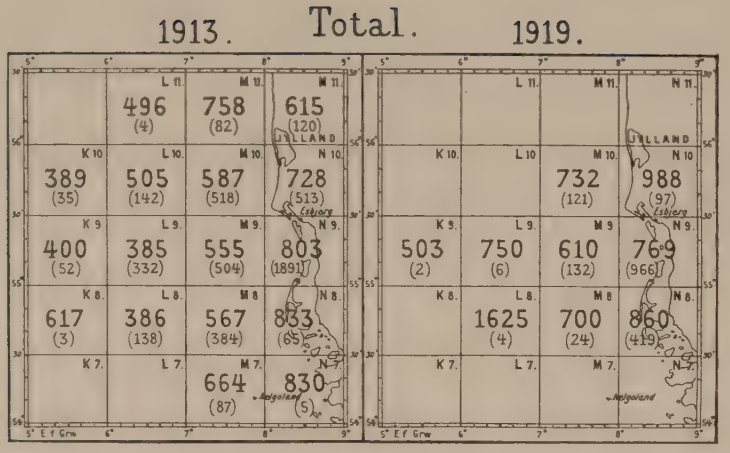

Fig. 6. Average catch of Plaice (in Kgs.) per fishing day of Danish cutters in 1913 and 1919. (Number of fishing days in brackets).

As plus B1 an average increase in weight per specimen of ca. 10.8 % has been observed. This increase has probably taken place during the war, so that the plaice in 1909—13 had about the same average size as in 1904—06.[1] If we start from this supposition, we find that no more specimens per fishing day have been landed from Area As and B1 in 1919 than in 1909—13, and this means a considerable decrease in the number of small plaice of ca. 25—30 cm length in the landings.[1]

For the two years: 1913 and 1919 I have made use of the rectangular area system in forming our data as to average catch per fishing day.

In Figs. 4 and 5 I have represented the average catch per fishing day for each month in 1913 and 1919 in those areas where the Danish plaice fishery from Esbjerg takes place, and in Fig. 6 I have given the average catch for the whole year. A comparison of the catch in 1913 and 1919 in the most important Small Plaice Areas is given below:

Average catch per fishing day in kgs. in various rectangular Areas.

	1913	1919	Increase %
N 8	833	860	3.2
N 9	803	769	— 4.2
N 10	728	988	35.7
M 8	567	700	23.5
M 9	555	610	9.9
M 10	587	732	24.7
All six Areas ...	709	788	11.1

It will be seen that the increase in weight is not great. The average increase in weight of catch is about the same as the increase in the average weight of the specimens. Thus we obtain here the same result as for the depth areas, viz. that there has been no increase in the number of specimens caught per fishing day from 1915 to 1919 but a decrease for the smaller sizes. In this connection it should be remembered that a very great number of the plaice originating from the spawning period 1914—15 just in 1919 in all probability had reached a length of 25—30 cm.

The information given here concerning the Danish cutters' average catch per fishing day on the Small Plaice Grounds of the eastern North Sea, does not afford any support for the view that the density of the young plaice population has increased since pre war years. It should however be remembered that the statistical information available regards only the landings, not the real catch on the fishing grounds. Now there is a probability that a change in the sorting of the plaice took place at the same time as the number of medium and large plaice on the grounds increased. The greater the quantity of medium and large plaice, the less the fishermen are interested in the landings of small plaice.[1]

[1] Compare A. C. Johansen and Kirstine Smith: Investigations as to the effect of the restriction on fishing etc. Medd. Komm. f. Havundersøgelser. Serie Fiskeri Bd V. No. 9. 1919. — Kirstine Smith: Danish investigations of Plaice from the North Sea. Ibd. Bd. VI. No. 2. 1921.

The catch per fishing boat during a season in the Graadeep Inshore Waters.

We shall now proceed to consider the catch of plaice in the Graadeep Inshore Waters for which we possess catch statistics for a series of years. Large or middle-sized plaice are never captured here, only small fishes. The sorting of the fishes has not changed much here, at any rate not since the season 1907—08, the majority of the landed fishes being always of a size between 22 and 27 cm. The size limit for landing (and sale abroad) was in the seasons 1907—08 to 1913—14 ca. 21 cm and in the seasons after 1914—15 22 to 22.5 cm. The sorting is not only influenced by the size limit but also to some degree by the sale price, as the fishermen are inclined to land a proportionately large number of small fishes when the price is high.

The capture of plaice in Graadeep is carried on from small boats. The gear most generally used is a small beam trawl with a beam of a length of ca. 3.5 meters. The average fishing power of the boats has increased during the course of years. Up to 1902 the boats were moved forward by the tide but since autumn of 1902 the fishermen began to use motor power in the fishery. At the beginning they used only small motors of ca. $1^1/_2$ H. P. Later on more powerful motors were used of 4—6 up to 10 H. P. Besides the beam trawl the snurrevaad has now and then been used for the fishery in later years.

Table 2 shows that the yield of the fishery has been very varying from one year to another, but proportionately low in the three seasons after the end of the war, both when we consider the total yield and the yield per boat. Again these statistics do not form any basis for the hypothesis that greater numbers of small plaice occurred after the end of the war than before, but owing to different circumstances the statistics possess only a very limited value when used as an expression for the changes in number of young plaice in the main areas of the Young Plaice Grounds. The area on which the plaice fishery chiefly takes place in Graadeep, is very small, only about 10—15 km². The great majority of the plaice which occur in Graadeep in autumn have not grown up in this area, but have immigrated from the grounds west of Fanö and Skallingen, and it is probable, that the number of plaice which occurs in Graadeep do not present for every year an equally reliable picture of the density of the plaice population on the outer grounds. Moreover, the fishery in the inshore waters at Graadeep has, to no slight degree, the character of occasional fishery, and the difficult sale conditions of later years have contributed materially to the fact that the fishery has not been carried out with great intensity. It should be remarked

Table 3. Yield of the inshore Plaice-Fishery from small boats from Esbjerg in various seasons.

Season	Tons	Value Kroner	Price per Kg. Øre	Fishing Period	Number of Boats	Average per Boat during season, Kgs.	Average pr. Boat during month of maximum yield, Kgs.
1898—1899	123	24.500	20	Dec.—Jan.	60	2042	1042 (Jan.)
1899—1900	272	43.614	16	Oct.—Dec.	110	2472	1243 (Nov.)
1900—1901	238	36.000	15.2	Oct.—Nov.	150	1583	1250 (Nov.)
1901—1902	83	18.000	21.6	Nov.—Dec.	80	1039	789 (Nov.)
1902—1903	13	2.680	21.2	Nov.	80	158	158 (Nov.)
1903—1904	96	19.200	20	Nov.	82	1171	1171 (Nov.)
1904—1905	260	52.000	20	Nov.—Dec.	130	2000	1038 (Dec.)
1905—1906	120	33.720	28	Nov.—Dec.	155	777	622 (Nov.)
1906—1907	306	73.500	24	Nov.—Dec.	162	1890	1260 (Nov.)
1907—1908	159	25.603	16.1	Oct.—Dec.	135	1176	637 (Nov.)
1908—1909	40	11.961	30	Nov.—Dec.	135	296	198 (Dec.)
1909—1910	43	6.000	13.8	Nov.—Dec.	123	352	271 (Nov.)
1910—1911	88	17.800	20.2	Oct.—Dec.	92	960	543 (Nov.)
1911—1912	284	51.030	18	Oct.—Jan.	112	2531	1186 (Nov.)
1912—1913	864	168.400	19.5	Oct.—Jan.	122	7082	3417 (Dec.)
1913—1914	1219	226.656	18.6	Oct.—Jan.	134	9094	4277 (Nov.)
1914—1915	191	38.500	20.1	Oct.—Jan.	112	1708	1116 (Nov.)
1915—1916	171	47.840	28	Nov.	139	1229	1229 (Nov.)
1916—1917	2217	1.323.922	59.7	Oct.—Dec.	203	10.922	7080 (Nov.)
1917—1918	486	131.634	27	Oct.—Feb.	225	2160	1104 (Dec.)
1918—1919	232	122.258	52.8	Oct.—Jan.	290	799	564 (Nov.)
1919—1920	58	29.000	50	Oct.—Jan.	197	294	162 (Nov.)

Fig. 7. No. of specimens of 0-Gr. of Plaice caught per hour with Young Plaice Trawl in the summer of 1920 (7. July—17. Aug.).

here that the statistics at hand do not offer any information with regard to the length of time in which each boat has partaken in the fishery. Statistics concerning the catch per boat and per fishing day can not be worked out.

The available statistics concerning the catch of plaice on the Small Plaice Grounds of the eastern North Sea, including Graadeep, suggest, as far as they reach, that the number of young plaice was not greater in the years 1919—20 than in pre war years. The statistics thus lend support to an opinion which is common among the Esbjerg fishermen, but it appears from the information given above that a definite proof for the correctness of this opinion cannot be derived from these statistics. Without undertaking systematic fishing experiments on a large scale it is very difficult to get sufficiently good material for a comparison between the frequency of young plaice in different periods.[1]

[1] On account of the lack of a research steamer for several years we have, up to now, not been able to resume our systematic fishing experiments by Otter-Trawl, but we have resumed our experiments with Young Plaice Trawl.

Fig. 8. No. of specimens of 0-Gr. of Plaice caught per hour with Young Plaice Trawl in the summer of 1921 (3. July—22. Septbr.).

Fishing experiments with Young Plaice Trawl in the North Sea.

In the Figures 7—10 are represented the number of plaice of the 0-Gr. and the I-Gr. caught per hour with young plaice trawl in 1920 and 1921 on the various stations. In order to compare the post war results with the pre war we have made a table showing the average catch per hour in the various years and in the areas represented on Fig. 1. We will consider here the areas 1—5 which are situated at the west coast of Jutland between Fanö and Hanstholm.

The figures given on p. 14 show that the catch of the 0-Gr. per hour was not extraordinarely high in 1920 and 1921 compared with the catch in the pre war years.

The catch appeared in 1920 and 1921 to be somewhat normal. It was greater than in the years 1911 and 1913 but much smaller than in the year 1912. Also the year 1909 gave in the southern areas a higher catch than any of the years 1920 and 1921.

The examination concerning the catch of the I-Group of plaice in the various years is not of as

Fig. 9. No. of specimens of I-Gr. of Plaice caught per hour with Young Plaice Trawl in the summer of 1920 (7. July—17. August).

Average catch per hour of specimens of 0-Gr. in the various areas 1—5 on the west coast of Jutland.

	Catch per hour							No. of stations						
Area	**1**	**2**	**3**	**4**	**4a**	**5**	**1—5**	**1**	**2**	**3**	**4**	**4a**	**5**	**1—5**
1921	64	93	17	128	..	229	105	7	9	7	6	..	7	36
1920	21	85	68	8	205	35	76	2	8	7	7	6	5	35
1913	..	..	4	6	48	21	21	.	.	2	10	7	5	24
1912	284	337	56	121	482	180	250	7	4	5	7	7	5	35
1911	13	8	8	21	34	88	28	7	7	5	8	6	6	39
1910	95	83	58	..	..	..	85	7	7	2	.	.	.	16
1909	105	128	25	..	..	..	94	7	12	7	.	.	.	26
1905	27	251	32	25	104	108	92	3	6	5	11	15	9	49

much interest as that of the 0-Group. The I-Gr. is distributed over a much wider area than the 0-Gr., and frequently the I-Group has not its maximum density at those depths where the fishing experiments are

Fig. 10. No. of specimens of I-Gr. of Plaice caught per hour with Young Plaice Trawl in the summer of 1921 (3. July—22. Septbr.).

Average catch per hour of specimens of I-Gr. in the various areas 1—5 on the west coast of Jutland.

	Catch per hour							No. of stations						
Area	**1**	**2**	**3**	**4**	**4a**	**5**	**1—5**	**1**	**2**	**3**	**4**	**4a**	**5**	**1—5**
1921	73	80	13	5	...	14	40	7	9	7	6	..	7	36
1920	22	35	7	0.3	24	2	15	2	8	7	7	6	5	35
1913	..	..	2	1	24	2	8	.	.	2	10	7	5	24
1912	17	27	3	1	13	3	10	7	4	5	7	7	5	35
1911	45	18	20	5	68	7	26	7	7	5	8	6	6	39
1910	125	35	22	.	..	.	73	7	7	2	.	.	.	16
1909	52	8	1	.	..	.	18	7	12	7	.	.	.	26
1907	32	43	.	.	..	.	36	4	2	.	.	.	.	6
1905	59	24	8	2	37	25	24	3	6	5	11	15	9	49

carried out. If it had been the aim to compare the density of the population of the I-Gr. in various years the fishing depths should have been more varying, and the number of experiments more numerous. In

this case it would also have been practical to use a larger fishing apparatus. When a comparison of the catch of the I-Gr. in the various years is given above, all reservation is taken with regard to the representative value of the material.

The main result of the comparison here is a similar one as for the 0-Gr. viz. that the years 1920 and 1921 were not distinguished by an unusually high catch compared with that in the pre war years. It should be noted that the great catch of 0-Gr. in the southern areas in 1909 was followed by a great catch of I-Gr. in 1910, while the great catch of 0-Gr. in the northern areas in 1912 was not followed by a great catch of I-Gr. in 1913. This was, however, the case in the Skagerak and northern Kattegat.

III. Investigations in the Skagerak and northern Kattegat.

The plaice of the Skagerak has the same racial-stamp as the plaice in the northern and middle part of the North Sea, and the same holds good with regard to the main part of the plaice in the northern Kattegat. It is also probable that an essential part of the plaice in the Skagerak and the northern Kattegat originate from plaice spawning in the North Sea. The Jutland Current carries the pelagic eggs and larvae from the North Sea to the Skagerak and northern Kattegat, and it has been proved by marking experiments that a great exchange of plaice takes place both between the North Sea and the Skagerak and between the Skagerak and the Kattegat.[1] Moreover, it has been shown by countings of fin rays that a great immigration of young plaice takes place from the Skagerak to the northern Kattegat.[2] Thus it will be of interest in connection with the investigations in the eastern North Sea to make a comparison between the catches of young plaice in pre war years and in post war years also in these waters, although an accumulation of large and old plaice corresponding to that in the North Sea has not been observed here.

Table 4. Total Yield in tons of the Plaice Fishery in the Skagerak and Kattegat.

Year	Denmark	Sweden	Germany	Total
1885	7579	..	..	7579
1886	6181	..	..	6181
1887	6749	..	..	6749
1888	4826	..	..	4826
1889	5793	..	..	5793
1890	6201	..	..	6201
1891	5410	..	..	5410
1892	6170	..	..	6170
1893	4089	287	..	4376
1894	5049	277	..	5326
1895	5744	336	..	6080
1896	5885	433	..	6318
1897	4344	456	..	4800
1898	6019	476	..	6495
1899	5480	515	..	5995
1900	3214	519	..	3733
1901	4855	527	..	5382
1902	5537	639	..	6176
1903	5327	682	169	6178
1904	4856	719	297	5872
1905	2974	740	335	4049
1906	3168	696	311	4175
1907	4911	637	382	5930
1908	4499	658	396	5553
1909	3569	608	323	4500
1910	3708	607	300	4615
1911	4185	599	290	5074
1912	3923	407	264	4594
1913	3522	397	265	4184
1914	4447	601	137	5185
1915	4019	962	101	5082
1916	2556	365	66	2987
1917	2884	501	85	3470
1918	2443	463	29	2935
1919	4132	387	207	4726
1920	2909	300	197	3406

On the yield of the plaice fishery in the Skagerak and the Kattegat.

Table 4 gives a survey of the total yield of the plaice fishery in the Skagerak plus Kattegat in the period 1885 to 1920.

For Denmark the statistics are worked out from the "Fiskeri-Beretning" and also for the period 1885—1908 from information concerning the weight per score of the plaice as contained in the journals of the Danish cutters.[3]

The statistics do not comprise the Danish cutter fishery for the Skagerak for the years 1885—1890, as we

[1]) A. C. Johansen: Contributions to the Biology of the Plaice I & II.

[2]) A. C. Johansen: Ueber die Schollenfischerei im Kattegat etc. Rapports et Procès-Verbaux vol. V. Cons. perm. internat.

[3]) By the conversion from number to weight for the years 1885—1908 for the stretch Skagen-Hals and the stretch Hanstholm—Skagen, the coefficients used are given in Table 10 and 11 of the author's "Bericht über die dänischen Untersuchungen über die Schollenfischerei etc." 1910.

only find satisfactory statistical information concerning the capture for one single year in this period. In this year (1887) the catch of the coast fishery amounted to ca. 935 tons. According to information in Fiskeritidende, it must be supposed that the yield was far greater in the years 1885 and 1889, whilst it was probably less in 1890.

Statistics concerning the Swedish fishery do not go further back than 1893.

Information concerning the catch of plaice from Sweden has been worked out for the years 1893—1920 from "Berättelse öfver Göteborgs och Bohus läns hafsfisken", "Hallands läns Hushållningssällskaps handlingar", "Malmöhus läns Hushållningssällskaps kvartalskrift", "Åtgärder för Fiskerinäringen i Sverige" and "Sveriges officiella Statistik".

The statistics concerning the capture of plaice from Germany in the Skagerak and Kattegat go back to 1903. The German capture is of no importance before the year 1897, when steam trawlers were employed by the fishery. The statistics concerning the German capture are taken from "Bulletin Statistique" and for the later years from information received from Henking.

The yearly average yield for the years 1885—1920 is according to Table 4 ca. 5169 tons. If we regard the yield in periods of 6 years, we obtain the following result:

Period	Yearly average catch in tons	Per cent of catch in 1885—90
1885—1890	6222	100.0
1891—1896	5613	90.2
1897—1902	5430	87.3
1903—1908	5293	85.1
1909—1914	4692	75.4
1915—1920	3767	60.5

We see here that the decrease in the average yield is very considerable. It is still greater than it appears in the survey, as the yields given for the three first periods and especially for the period 1885—1890 are deficient.

The low yield in the years 1916—18 can be explained as an effect of the restrictions on fishing during the war. But the low yield in 1919 and especially in 1920 is extraordinary as the fishery was taken up with rather great intensity after the end of the war.

We can hardly doubt that the decrease in the yield is due at least partly to a decrease in the stock of large and old fishes.

Extracts from the Danish cutters' journals, together with information from other sources, show that numerous large plaice were landed from the Skagerak in the eighties of the past century, and that a gradual decrease in the average size of the landed fishes occurred until the middle of the nineties (Johansen l. c. 1910). We have also noticed, that the number of old and mature plaice has gradually decreased in the catches from the Kattegat during a long series of years up to the beginning of the war. The question now presents itself, whether the decrease in the yield is due solely to the decrease in the stock of the old and mature fishes or whether the decrease may be noticed also in the stock of the young marketable plaice.

In order to procure some information concerning this question we shall consider the plaice catch in the Skagerak and in the northwestern Kattegat over a series of years.

Since the middle of the nineties no great quantities of old

Table 5. Yield in Tons of the Danish and German Plaice Fishery in the Skagerak. (Yield of the Boat Fishery from Skagen in the Skagerak not included).

Year	Denmark	Germany	Total
1895	2344	?	c. 2344
1896	1685	?	c. 1685
1897	1244	?	c. 1244
1898	919	?	c. 919
1899	1080	?	c. 1080
1900	314	?	c. 314
1901	1155	?	c. 1155
1902	1637	?	c. 1637
1903	1527	121	1648
1904	1556	203	1759
1905	774	164	938
1906	868	128	996
1907	1011	267	1278
1908	1199	234	1433
1909	559	186	745
1910	540	123	663
1911	812	71	883
1912	720	119	839
1913	412	97	509
1914	261	28	289
1915	184	11	195
1916	152	0	152
1917	315	0	315
1918	148	0	148
1919	413	207	620
1920	585	145	630

Table 6. Catch of Plaice in Tons in the Skagerak and Kattegat from boats from Skagen.

Year	Skagerak	Kattegat	Total
1895	..	..	650
1896	..	..	1115
1897	..	..	1115
1898	..	..	1671
1899	..	..	977
1900	..	..	398
1901	..	..	673
1902	..	..	1008
1903	..	..	994
1904	..	..	617
1905	..	..	646
1906	..	..	903
1907	..	..	794
1908	..	..	943
1909	535	176	711
1910	504	78	582
1911	497	101	598
1912	524	394	918
1913	537	425	962
1914	412	558	970
1915	438	506	944
1916	299	191	490
1917	277	231	508
1918	155	152	307
1919	289	130	419
1920	174	108	282

mature plaice were landed from the Skagerak and from the northwestern Kattegat. The great majority of the plaice landed from these waters during the years 1895—1920 were young immature plaice or fishes approaching maturity for the first time. As far as we are able to judge, according to the age analyses from the period 1905—1922, the majority of the landed specimens belong to the age groups II—VI. (A. C. Johansen l. c. 1910 — Table 9 and 10 of this paper).

In Table 5 a survey is given concerning the yield in tons of the Danish and German plaice fishery in the Skagerak during the period 1895—1920. The table does not include the yield of the boat fishery from Skagen in the Skagerak, as this can be given only for the years from 1909 and onwards. (The yield from the total boat fishery from Skagen in the Kattegat as well as in the Skagerak is entered in Table 6).

Table 5 shows, besides great fluctuations, an enormous decrease in the yield of the fishery in the Skagerak during the period in question.

From Table 6 we get also an impression of a noticeable decrease in the yield of the fishery. For the period 1909—20 we notice a steady decrease in the Skagerak and great fluctuations in the Kattegat. The maximum yield was obtained in the area around Skagen in the year 1898. The fishery which takes place from small boats in the neighbourhood of the coast was not materially restricted by the war measures, and the decrease in the yield is continued till the very latest years.

Some age determinations of plaice from the neighbourhood of Skagen in the spring af 1922 show that the marketable young plaice have had a very rapid growth (Table 9 and Table 10). This fact suggests also that here is no great stock of young marketable plaice at present.

Table 7. Yield of the Plaice Fishery in Aalbæk Bay and Hertha's Flak from boats of the villages at Aalbæk Bay (including catch of boats from Skagen).

Year	Catch in Tons	Year	Catch in Tons
1909	293	1915	**639**
1910	235	1916	336
1911	282	1917	516
1912	427	1918	281
1913	444	1919	381
1914	**626**	1920	342

Table 7 comprises the yield of the plaice fishery from the small fishing places at the Aalbæk Bay together with the yield of the catch from Skagen boats in the Kattegat. The capture from these areas takes place on the Small Plaice Grounds of the Aalbæk Bay and Hertha's Flak. The majority of the specimens landed from this area are of a length between 24 and 33 cm and belong to the II-Gr. and III-Group.

The Table shows that the yield of the fishery is very variable. It was unusually large in 1914 and 1915. The yield in 1919 and 1920 was below the average for the whole period 1909—1920.

There is no doubt that the intensity of fishing for plaice has increased, on the whole, in the Skagerak and northwestern Kattegat in the period from 1895 to 1914. The statistics for the Skagerak suggest that there has been a decrease in the stock of young marketable plaice in the said period. In the northwestern Kattegat there has been very great fluctuations in the yield, and it can not yet be decided whether or not there has been a general tendency to a decrease.

In Kattegat, taken as a whole, the stock of old mature plaice has become greatly reduced in the last decennaries. As a consequence of this the growth of plaice has increased in the areas which were

mainly populated by the old fishes. During several later years the plaice fishery in the Kattegat has been based mainly on rather young plaice of the age from ca. 2 to 7 years, among which however many more mature specimens occur than in the Skagerak-stock. If we examine the statistics concerning the fishery for the period 1909—20 (Table 8) it will be seen that the decrease in the yield during the war was not extraordinarily great, but the yield in 1919 and 1920 has not been great either in proportion to the yield in the period 1909—14. In 1920 the yield has even been remarkably low in spite of the fact that good prices were obtained for the fish. In Kattegat it appears that the restrictions on the fishing during the war have neither resulted in a considerable stock of old nor of young plaice.

With regard to the statistics concerning the plaice fishery in the Kattegat it should be remarked, that the yield given for Sweden also includes the fishery in the Skagerak, as it is not possible to keep the yield from these waters apart.

Table 8. Total yield in Tons of the Plaice Fishery in the Kattegat.

	Denmark	Sweden	Germany	Total		Denmark	Sweden	Germany	Total
1909.....	3010	608	137	3755	1915.....	**3835**	**962**	90	**4887**
1910.....	3168	607	177	3952	1916.....	2404	365	66	2835
1911.....	3373	599	219	4191	1917.....	2569	501	85	3155
1912.....	3203	407	145	3755	1918.....	2295	463	29	2787
1913.....	3110	397	168	3675	1919.....	3719	387	0	4106
1914.....	**4186**	601	109	**4896**	1920.....	2324	300	52	2676

Table 9. Age Analyses of Plaice caught by Snurrevaad NW. of Skagens Light in 24 meters depth on March 13th, 1922.

(Purchased sample).

Sex	♂								♀										♂+♀						
Age group....	II		III		IV	?	Total		II	II or III	III		IV		V	?	Total		II	II or III	III	IV	V	?	Total
Maturity	im.	m.	im.	m.	im.	im.	im.	m.	im.	m.	im.	m.	im.	m	im.	im.	im.	m.	im. + m.	m.	im. + m.	im. + m.	im.	m.	im. + m.
Length cm																									
23.....	1	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1
26.....	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1
27.....	5	..	..	..	..	..	5	..	2	..	..	..	..	..	..	..	2	..	7	..	..	..	..	..	7
28.....	6	..	..	..	..	..	6	..	4	..	..	..	..	..	..	1	5	..	10	..	..	..	..	1	11
29.....	..	..	1	..	..	..	1	..	1	..	..	..	..	..	..	..	1	..	1	..	1	..	..	..	2
30.....	3	2	1	1	1	..	5	3	3	..	..	..	..	..	..	2	5	..	8	..	2	1	..	2	13
31.....	5	..	..	..	..	1	6	..	2	..	1	..	..	..	..	1	4	..	7	..	1	..	..	2	10
32.....	1	..	..	1	..	..	1	1	3	..	2	..	..	..	..	1	6	..	4	..	3	..	..	1	8
33.....	..	1	3	1	..	..	3	2	3	..	4	1	2	..	..	..	9	1	4	..	9	2	..	..	15
34.....	2	..	2	..	1	..	5	..	1	..	2	..	..	..	1	..	4	..	3	..	4	1	1	..	9
35.....	..	..	..	..	..	..	..	..	..	..	7	1	3	2	..	..	10	3	..	..	8	5	..	..	13
36.....	..	..	1	..	..	..	1	..	..	..	1	..	1	..	..	1	3	..	..	..	2	1	..	1	4
37.....	1	1	..	..	..	..	1	1	1	1	1	..	1	..	..	..	3	1	3	1	1	1	..	..	6
38.....	..	..	..	..	1	..	1	..	..	..	1	..	1	..	..	..	2	..	..	..	1	2	..	..	3
39.....	..	..	1	..	..	..	1	..	2	..	..	..	..	..	..	..	2	..	2	..	1	..	..	..	3
40.....	..	..	..	..	..	..	..	..	..	..	1	..	1	1	1	..	3	1	..	..	1	2	1	..	4
41.....	..	..	..	..	..	..	..	..	1	..	2	..	1	..	..	..	4	..	1	..	2	1	..	..	4
42.....	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	..	1	..	..	..	1
43.....	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1	..	..	..	..	1	..	..	1
44.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
45.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	1	1
Total number.	24	4	9	3	4	1	38	7	23	1	22	3	11	3	2	7	65	7	51	1	37	18	2	8	117
Aver. length..	29.5	32.5	33.4	31.2	32.0	31.0	30.74	32.1	31.8	37.0	35.1	36.7	36.9	36.7	37.0	33.1	34.11	36.7	30.8	37.0	34.6	35.8	37.0	32 9	33.05

Table 10. Age Analyses of Plaice caught by Snurrevaad S. by W. of Skagens Light in 20 meters depth on April 5th, 1922.
(Purchased sample.)

Sex	♂									♀										♂+♀							
Age group	II	III		IV		V		Total		II	III	IV		V	VI	VII	?	Total		II	III	IV	V	VI	VII	?	Total
Maturity	im.	im.	m.	im.	m.	im.	m.	im.	m.	im.	im.	im.	m.	im.	im.	im.	im.	im.	m.		im. +m.	im. +m.	im. +m.	im.	im.	im.	im. +m.
Length cm																											
25	1	11	..	1	..	..	..	13	..	1	3	..	..	..	..	..	..	4	..	2	14	1	..	..	..	..	17
26	1	6	..	2	..	..	..	9	..	2	5	2	..	..	..	..	..	9	..	3	11	4	..	..	..	..	18
27	..	3	..	1	..	..	..	4	..	..	8	2	..	..	..	..	..	10	..	..	11	3	..	..	..	..	14
28	1	7	..	2	..	..	.	10	..	..	7	1	..	..	..	..	..	8	..	1	14	3	..	..	..	..	18
29	..	6	1	1	..	..	1	7	2	..	6	4	..	..	..	1	..	11	..	..	13	5	1	..	1	..	20
30	..	3	..	4	..	..	..	7	..	..	6	9	..	..	..	..	..	15	..	..	9	13	..	..	..	..	22
31	..	6	..	4	1	..	..	10	1	..	2	6	..	2	..	..	1	11	..	..	8	11	2	..	..	1	22
32	..	2	..	2	..	1	..	5	..	..	5	5	..	2	1	..	..	13	..	..	7	7	3	1	..	..	18
33	..	1	1[1]	2	..	..	..	3	1	..	2	3	2	3	1	..	..	9	2	..	4	7	3	1	..	..	15
34	..	..	..	1	..	..	..	1	..	..	1	1	..	..	..	..	..	2	..	..	1	2	..	..	..	..	3
35	..	..	..	..	..	..	..	..	..	..	1	3	..	..	..	..	..	4	..	..	1	3	..	..	..	..	4
36	..	..	1	..	..	..	..	..	1	..	..	3	1	..	..	..	..	3	1	..	1	4	..	..	..	..	5
37	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	1	1	..	..	2	..	..	..	..	2
38	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	..	1	..	..	..	..	1
39	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1
40	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
41	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
42	..	..	..	..	..	..	.	..	..	..	..	..	1	..	..	..	..	..	1	..	..	1	..	..	..	..	1
Total number	3	45	3	20	1	2	1	70	5	3	46	40	6	7	2	1	1	100	6	6	94	67	10	2	1	1	181
Aver.length	26.3	27.9	32.7	29.9	31.0	35.5	29.0	28.60	31.6	25.7	28.87	31.2	36.5	32.1	32.5	29.0	31.0	30.04	36.5	26.0	28.52	31 28	32.5	32.5	29.0	31.0	29.74

[1] Maturity doubtful.

Fishing experiments with Young Plaice Trawl in the Skagerak and Kattegat.

The results of the fishing experiments with young plaice trawl in the Skagerak and Kattegat in 1920 and 1921 are represented in the Figures 7—10 and for the areas 6—10 they are combined in the Tables below for comparison with the pre war experiments. (As to the situation of the various coastal areas see Fig. 1. p. 4.)

Average catch per hour of Plaice of 0-Gr. in the Skagerak and northern Kattegat.

	Catch pr. hour						No. of stations					
Area	6	7	8	9	10	6—10	6	7	8	9	10	6—10
1921	144	218	194	87	255	181	11	5	7	4	7	34
1920	43	18	39	33	76	44	19	6	6	3	8	42
1913	121	42	40	16	12	61	12	6	6	4	6	34
1912	414	388	281	112	54	289	16	6	6	5	7	40
1911	95	79	172	136	375	151	14	6	7	4	5	36
1910	..	44	83	35	38	55	..	2	6	4	4	16
1909	21	16	33	19	32	25	2	7	6	4	6	25
1907	..	..	64	18	110	64	..	..	5	2	2	9
1906	..	67	33	43	18	43	..	5	8	6	2	21
1905	203	106	12	44	9	106	17	5	11	3	5	41

It will be seen that the catch was less than normal in 1920 but greater than normal in 1921. In 1912, however, the catch was still greater than in 1921. The great catch in 1912 was, as stated before also characteristic for the North Sea coast of Jutland (Area 1—5). The great catch in 1911 in Area 8—10, is essentially a Baltic phenomenon. It appeared also in the southern Kattegat and the Belt Sea. (A. C. Johansen: Contributions VI. 1913). In the Skagerak the catch was in 1905 greater than normal and greater also than the catch in 1921.

Average catch per hour of Plaice of I-Gr. in the Skagerak and northern Kattegat.

	Catch per hour						No. of stations					
Area	6	7	8	9	10	6—10	6	7	8	9	10	6—10
1921	24	6	86	27	124	55	11	5	7	4	7	34
1920	2	4	15	17	66	17	19	6	6	3	8	42
1913	42	2	466	101	57	119	12	6	6	4	6	34
1912	4	9	17	4	1	6	16	6	6	5	7	40
1911	7	9	26	4	4	10	14	6	7	4	5	36
1910	.	26	183	7	10	76	..	2	6	4	4	16
1909	1	11	35	2	5	14	2	7	9	5	8	31
1907	51	..	59	3	16	44	2	.	12	2	4	20
1906	..	117	40	13	3	47	.	5	8	6	2	21
1905	49	309	58	18	1	75	17	5	11	3	5	41

It will be seen that the greatest catch was in 1913, the year after the maximum catch of 0-Gr. In 1921 the catch was high in Area 10, small in Area 7 and normal in the other areas. In 1920 the catch was in most areas less than normal.

IV. On the value of the systematic fishing experiments as a means of showing variations in the frequency of Young Plaice.

The question naturally arises whether we have any evidence to the effect that the systematic fishing experiments, which were carried out with Young Plaice Trawl, are of any real value, for the investigation of the variation in the frequency of the young plaice from one year to another. For various reasons we are inclined to regard investigations of this nature with a certain scepticism. Among factors which may exercise a disturbing influence upon the results obtained, the following ones should be mentioned:

1) The population of the 0-Group of the plaice is not equally distributed, not even within very limited areas. The density of the population is highly variable from one place to another, and small differences for example with regard to depth or bottom may be followed by great differences in the density of the population.
2) Different young plaice trawls do not possess the same fishing power even if the dimensions of the gears are the same. Quite small differences in the construction, or in the weight of the ground rope etc. may cause considerable differences with regard to the fishing power.
3) The speed with which the trawl is moved along the bottom influences the capture, and it must be varied according to the direction and power of the currents. The speed may in certain years have been chosen more advantageously than in other years.
4) The weather has a considerable influence on the capture. If the sea is rough it will greatly influence the capture with such a light gear as the young plaice trawl.
5) Also the transparency of the water does undoubtedly influence the capture. In very transparent water the plaice escape the gear more easily than in less transparent water.

In spite of the influence of all these disturbing factors important evidence is however available to show that no slight importance should be attributed to the results of the fishing experiments carried out. In different places fluctuations in the yield of the practical fishery have been noticed which are evidently in accordance with the observed fluctuations in the capture of young plaice in the fishing experiments. A comparison between the captures of the 0-Group of the plaice and the statistics concerning the yield of the plaice fishery in the Graadeep Inshore Waters (Table 3) is especially instructive in this respect. As mentioned before, the small fishes of a length of 21—27 cm are quite in the majority in the catches here, and they mainly belong to the III-Group and IV-Group. The statistics concerning the yield

shows now that two very marked maxima occurred in the period 1896—1920 both with regard to the total yield and the yield per fishing boat during the month of maximum yield. These maxima occur in the seasons 1912—13 and 1913—14 and 1916—17. The first maximum, comprising two seasons, thus appears 3 and 4 years respectively after the relatively large capture of the 0-Group of the plaice in area 1 and 2 in 1909, and 2 and 3 years respectively after the relatively large catch of the I-Group. The most marked maximum in the yield of the practical fishery in 1916—17 falls 4 years after the equally strongly marked maximum in the capture of the 0-Group of the plaice in 1912 (see p. 11 and p. 14).

As stated above a proportionately large number of plaice of the 0-Gr. were captured at the coasts of Skagerak and the northern Kattegat in 1912, and in the next year a proportionately large number of specimens of the I-Gr. were taken. Table 7 shows that the yield of the boat fishery in the Aalbæk Bay and Hertha's Flak was unusually high in 1914 and 1915. As several age analyses show that the main part of the plaice landed from these Small Plaice Grounds belong to the II-Gr. and III-Gr.,[1]) it can hardly be doubted, that it is the large amount of fry of the year class 1912 which causes the great yield of the fishery in 1914 and 1915.

In the middle and southern Kattegat an exceptional large number of plaice of the 0-Gr. were caught in 1911, whilst the year class 1912, as stated above, was numerously represented in the northern Kattegat. It is of interest in this connection to note that the yield of the plaice fishery in the Kattegat was proportionately high in the years 1914 and 1915 in spite of the fact that the fishery in these years was checked to a certain extent by the war operations, (see Table 8). The specimens of the II-Gr., the III-Gr. and the IV-Gr. constitutes nowadays a very essential part of the plaice which are landed from the Kattegat.

As regards the other evidence available regarding the significance of the systematic fishing experiments as a means of showing variations in the frequency of young plaice from one year to another we must refer to a previous paper of the author »On the variation in Frequency of Young Plaice in Danish Waters in 1902—1907« (l. c. 1908).

V. Concluding remarks about the results of the investigations.

In the preceding chapters we have seen, that the investigations in the eastern North Sea and the Skagerak do not suggest that greater numbers of young plaice are present in the post war years than in the later pre war years. The fishing experiments with Young Plaice Trawl have shown that the years 1920 and 1921 are not distinguished by exceptionally large or small numbers of the plaice of the 0-Gr. By examining the Danish cutters' catch per fishing day on the Small Plaice Grounds in the eastern North Sea, we have found that the average catch in 1919 was higher with regard to weight than the average catches in the year 1909—1913, but comprised fewer specimens of the smaller sizes.

Thus the great increase in the stock of spawning plaice in the North Sea, which occurred in consequence of the restriction on fishing during the war, has not given rise to the occurrence of a greater number of young plaice at the Danish coasts than is normally the case. The number of fry which develop and grow up in a certain water is undoubtedly dependent to some degree on the magnitude of the stock of spawning fishes, but the great changes observed in the number of young plaice from one year to another are evidently due chiefly to other causes. These causes are, in the main, still unknown but with regard to the North Sea they can hardly be ascribed to changes in temperature or contents of salts or oxygen of the water. In the North Sea we do not, as far as these factors are concerned, reach any disastrous minimum. The main reason of the yearly changes in the number of fry must rather be sought for either in the want of suitable food or in the occurrence of too many foes during some or other of the

[1]) Meddelelser fra Kommissionen for Havundersøgelser, Ser. Fiskeri, Bd. III No. 4. 1908 and Bd. III No. 8. 1910.

developmental stages of the plaice. At the same time as the stock of plaice has increased highly in consequence of the restriction on fishing during the war, some of the worst enemies of the young plaice, the cod among others, may also have increased strongly.

The general statistics of catch for the North Sea afford an evidence of a decrease in the stock of old and large plaice in the period from 1902 to 1914, but no evidence of a decrease in the stock of young marketable plaice. The statistics for the Skagerak give evidence of a decrease in the stock of old and large plaice in the period from 1885 to 1895 and also of a decrease in the stock of young marketable plaice after that period.

Miss A. G. Davin has been good enough to read through the proofs.

DANSK RESUMÉ.

A. C. Johansen: Undersøgelser angaaende Hyppigheden af unge Rødspætter i den østlige Del af Nordsøen og Skagerak i Aarene før Krigen og i Aarene efter Krigen.

Ved Undersøgelser fra England, Holland, Tyskland og Danmark under og efter Verdenskrigen er det blevet paavist, at Sammensætningen af Rødspættebestanden i Nordsøen er undergaaet en stor Forandring, der maa forklares som en Følge af Indskrænkningen i Fiskeriet under Krigen. De store og middelstore Rødspætter blev langt almindeligere, end de havde været i en Aarrække, og ved Undersøgelser fra tysk Side af Professor Mielck blev det fastslaaet, at de pelagiske Rødspætteæg var tiltaget stærkt i Hyppighed samtidig med, at Mængden af de store Rødspætter var forøget. — Under disse Forhold synes det ønskeligt at undersøge, om ogsaa Ungfisken i Nordsøen og Skagerak var tiltaget i Hyppighed. Det Materiale, der er tilvejebragt fra dansk Side til Oplysning om dette Spørgsmaal, kan deles i tre forskellige Grupper. Det bestaar for det første af statistiske Oplysninger om Totalfangsten fra dansk Side paa Opvækstgrundene for Rødspætten i den østlige Del af Nordsøen samt Skagerak og det nordvestlige Kattegat. For det andet bestaar det af statistiske Oplysninger om Fangsten pr. Fiskedag fra danske Fiskefartøjer i visse af de samme Omraader, og endelig af Resultaterne af en Række systematiske Fiskeforsøg, der i en Aarrække er blevet foretaget af Kommissionen for Havundersøgelser.

De systematiske Fiskeforsøg er overvejende udført paa ganske grundt Vand langs de danske Kyster. Som Redskab er herved anvendt en lille finmasket Skovltravl, der Aar efter Aar har den samme Størrelse og Konstruktion. Denne Travl benyttes fra en Motorbaad, som Regel paa Dybder fra 1 til 3 Meter, hvor Rødspætten af yngste Aldersgruppe (den saakaldte 0-Gr.) forekommer med størst Hyppighed paa den Tid af Aaret, hvor Fiskeforsøgene fortrinsvis foregaar, nemlig i Maanederne Juli, August og September. Paa samme Dybder og samme Aarstid er Rødspætterne af næstyngste Aargang (den saakaldte I-Gr.) paa de fleste Steder ogsaa ret talrigt repræsenteret.

Den finmaskede Skovltravl kan kun anvendes under rolige Vejrforhold, og den benyttes som Regel kun paa Steder, hvor der er ren Sandbund og ingen — eller kun ganske ringe — Bevoksning af Alger eller Havgræsser. Travlen slæbes over Bunden med en Hastighed af 1—1½ Sømil i Timen. Varigheden af de enkelte Travltræk har hyppigst været 30 Minutter. Naar Fangsten fra forskellige Træk skal sammenlignes, beregnes Antallet af fangede Individer efter Træk paa een Times Varighed, der saaledes er den anvendte Fiske-Enhed.

For at sammenligne Antallet af Rødspætter af 0-Gr. eller I-Gr. fanget pr. Time med finmasket Skovltravl i forskellige Aar, har vi for det første konstrueret Kort, hvor alle de tagne Stationer for hvert Aar er anført med Antallet af Individer fanget pr. Time. Dernæst har vi beregnet Gennemsnitstallet for Fangsten pr. Time fra alle Stationer indenfor visse bestemte Omraader (anført paa Figur 1 Side 4). Det er tilsigtet, at disse forskellige Omraader skulde have en naturlig Afgrænsning. Indenfor hvert enkelt af Omraaderne findes der ikke meget store Forskelligheder med Hensyn til Vandets Middelsaltholdighed (Fig. 2 Side 5).

Ved disse systematiske Fiskeforsøg, der er udført i Forbindelse med Aldersbestemmelser af Fisken (ved Undersøgelser af Ørestenene), har vi fundet, at de unge Rødspætter ikke forekommer tilnærmelsesvis med samme Hyppighed paa de samme Steder i forskellige Aar. For ethvert af de undersøgte Omraader har vi iagttaget, at Yngelen forekommer i stor Mængde i visse Aar, medens den optræder mindre hyppigt og undertiden meget sparsomt i andre Aar.

II. Undersøgelser i Nordsøen.

Total-Udbyttet af Rødspættefiskeriet.

I Tabel 1 (Side 6) er der givet en Oversigt over det aarlige Udbytte i Tons af Rødspættefiskeriet i Nordsøen i Aarene 1892—1920 fra de fem Lande: Danmark, Tyskland, Holland, England og Skotland. Over 95 % af Udbyttet af Rødspættefiskeriet i Nordsøen stammer fra disse fem Lande. Ogsaa Fangsten fra Belgien har nogen Betydning, men de statistiske Oplysninger fra dette Land har ikke kunnet tilvejebringes for saa lang en Aarrække som for de øvrige Lande. For Aarrækken 1904—1912 var det aarlige Gennemsnitsudbytte af det belgiske Rødspættefiskeri i Nordsøen ca. 1200 Tons. Rødspættefangsten i Nordsøen fra Norge og Frankrig er ganske minimal.

Tabellen er udarbejdet paa Grundlag af den officielle Statistik fra de forskellige Lande, samt efter »Bulletin Statistique« og efter en Afhandling af Dr. Kyle i Rapports et Procès-Verbaux, Vol. III, 1905. For Aarene 1892—1902 omfatter Statistiken for England og Skotland ogsaa Rødspætter fangede ved Island og Færøerne. Mængden af disse androg i Aaret 1903 5000 à 6000 Tons, men det vides ikke, om det drejer sig om større eller ringere Mængder for Aarene 1892—1902.

Som almindelig bekendt foregaar det danske og det hollandske Rødspættefiskeri i Nordsøen overvejende paa Opvækstgrundene for de unge Rødspætter indenfor 30 Meter Kurven. Det tyske og det engelske Fiskeri foregaar i betydelig Udstrækning baade paa de samme Opvækstgrunde og paa dybere Vand eller langt fra Land, hvor de større og ældre Rødspætter fortrinsvis findes, og det skotske Rødspættefiskeri foregaar næsten udelukkende paa dybere Vand.

Betragter man nu Udbyttet for de forskellige Lande, er det iøjnefaldende, at det store Udbytte i 1919 og 1920 i Forhold til Udbyttet i de sidste Aar før Krigens Begyndelse (1910—13) ikke falder paa de Nationer, der overvejende driver Fiskeriet paa Rødspættens Opvækstgrunde, men paa de Nationer, hvis Rødspættefiskeri overvejende eller i meget væsentlig Grad foregaar paa dybere Vand i Nordsøen. Gennemsnitsudbyttet af det danske Rødspættefiskeri var i Aarene 1919—20 betydeligt mindre end i 1910—13, og Gennemsnitsudbyttet af det hollandske Fiskeri var i 1919—20 noget mindre end i 1910—13. Statistiken over Totaludbyttet giver saaledes intet Holdepunkt for den Antagelse, at Mængden af unge Rødspætter i Nordsøen skulde være tiltaget som Følge af Krigsfredningen, men den kan heller ikke afgive Bevis for den modsatte Opfattelse, idet der i alt Fald for det danske Fiskeris Vedkommende er specielle Grunde til det forholdsvis ringe Udbytte af Fiskeriet i 1919 og 1920. Der kan saaledes for det første peges paa, at fra og med Aaret 1916 gik en væsentlig Del af den danske Kutterflaade over til at drive Kullerfiskeri med Snurrevaad i Stedet for Rødspættefiskeri. For det andet kan der henvises til, at det vigtigste danske Marked for Rødspætter i Udlandet, nemlig Tyskland, efterhaanden svigtede paa Grund af den tyske Valutas Sammenbrud[1].

[1] Dette Forhold har foranlediget, at stedse flere danske Fiskere i de senere Aar efterhaanden har søgt til England for at drive Fiskeriet fra engelsk Havn.

Det danske Rødspættefiskeri i den østlige Del af Nordsøen er i de siden Krigens Slutning forløbne Aar af disse Grunde ikke blevet drevet saa intensivt som i Aarene forud for Krigen.

Statistiken i Tabel 1 over Udbyttet af Rødspættefiskeriet i Nordsøen fra de forskellige Nationer giver Anledning til endnu et Par Bemærkninger. Det fremgaar af Statistiken, at Udbyttet af det danske Fiskeri steg overordentlig stærkt fra 1892 til 1913, og at Udbyttet af det hollandske Fiskeri steg ret jævnt i Perioden 1892—1911. For Tysklands Vedkommende var Udbyttet i Perioden 1892—1902 noget højere end i Perioden 1903—1913, men dette kan maaske hidrøre fra, at Statistiken i førstnævnte Periode ogsaa omfatter en Del Rødspætter taget ved Island og i Skagerak. Betragter vi England og Skotland, møder der os et helt andet Billede. Først iagttages en væsentlig Opgang i Udbyttet i Perioden 1892—1901-02, og dernæst et meget stærkt Fald i Udbyttet fra 1902-03 til Krigens Begyndelse. Dette Forhold peger i Retning af, at Rødspættebestanden paa dybere Vand (eller fjernt fra Kysterne), som England og Skotland i væsentlig Grad baserede deres Fiskeri paa, ikke har været nær saa modstandsdygtig overfor det intensive Fiskeri som Bestanden paa Opvækstgrundene, der danner Hovedgrundlaget for det hollandske og det danske Fiskeri. Dette staar uden Tvivl i Forbindelse med, at Bestanden af store og middelstore Rødspætter paa dybere Vand ikke fornyes saa hurtigt ved Opvækst som Bestanden af smaa Rødspætter i Kystbeltet.

Gennemsnitsfangsten pr. Fiske-Enhed.

For fire Aar fra Tiden før Krigen og et Aar efter Krigen er vi i Besiddelse af statistiske Oplysninger om Gennemsnitsfangsten pr. Fiskedag fra Kuttere, der driver Fiskeri fra Esbjerg i den østlige Del af Nordsøen. Det vil være af Interesse at sammenligne Resultaterne for disse fem Aar, ikke mindst i Area A_8, og Area B_4 (se Fig. 3 Side 7), hvor de unge Rødspætter er særlig talrige.

Tabel 2 Side 9 viser, at der i det hele er en Tiltagen i Fangsten efter Vægt pr. Fiskedag fra Perioden 1909—13 til 1919. Men denne Tiltagen er ikke stor for de vigtigste Opvækstgrunde. For A_3 andrager den kun ca. 9.5 Procent, og for B_4 12.2 Procent. I Perioden fra 1904—06 til 1919 er der for de samme Area iagttaget en Tiltagen i Vægten pr. Individ af de ilandbragte Fisk paa 10.8 Procent. Denne Tiltagen i Gennemsnitsstørrelsen har efter al Sandsynlighed fundet Sted under Krigen, saaledes at Rødspætten i Aarene 1909—13 havde omtrent samme Størrelse i de samme Area som i 1904—06. Hvis vi gaar ud fra dette, finder vi, at der ikke er ilandbragt flere Individer pr. Fiskedag fra Area A_3 plus B_4 i 1919 end i 1909—13, og dette betyder en betydelig Nedgang i Antallet af smaa Rødspætter af ca. 25—30 cm af de ilandbragte Fisk.[1]

For de to Aar 1913 og 1919 har jeg anvendt den i England og Frankrig benyttede Inddeling af Nordsøen i smaa Firkanter ved Behandlingen af det statistiske Materiale vedrørende Fangsten pr. Fiskedag. I Fig. 4 og 5 (Side 8 og 9) er angivet vore Kutteres Gennemsnitsfangst pr. Fiskedag i disse Firkanter for hver Maaned i de to Aar 1913 og 1919, og i Fig. 6 (Side 10) er Gennemsnitsfangsten opgjort aarsvis for de samme to Aar. For de 6 vigtigste Area (N_{8-10} og M_{8-10})var Gennemsnitsudbyttet i 1913 709 kg i 1919 788 kg, hvad der giver en Tilvækst af 11.1 %. Denne Tilvækst er her omtrent den samme som Tilvæksten i Individernes Gennemsnitsvægt. Vi kommer da ogsaa ved denne Sammenligning til det Resultat, at der i 1919 er fanget færre af de mindre Individer af ca. 25—30 cm Længde pr. Time paa Opvækstgrundene ved Jyllands Vestkyst end i 1913. Det maa i denne Sammenhæng erindres, at en Mængde af de Rødspætter, der stammer fra Gydeperioden 1914—15, netop i 1919 maa antages at opnaa en Længde af 25—30 cm.

De Oplysninger, der her er givet angaaende de danske Kutteres Gennemsnitsfangst pr. Time paa de vigtigste Opvækstgrunde for de unge Rødspætter udfor Jyllands Vestkyst, taler saaledes ikke for, at Mængden af unge Rødspætter skulde være tiltaget i Aarene fra 1909—13 til 1919. Det maa imidlertid erindres,

[1] A. C. Johansen & Kirstine Smith l. c. 1919. Kirstine Smith l. c. 1921.

at de forhaandenværende statistiske Oplysninger angaar kun de ilandbragte Fangster, ikke den virkelige Fangst paa Fiskegrundene, og der er Sandsynlighed for, at Sorteringen af Fisken er undergaaet en Forandring samtidig med, at Antallet af store og middelstore Rødspætter paa disse Grunde er tiltaget. Jo flere store Rødspætter, der findes paa Fiskegrundene, des mindre er Fiskerne interesserede i at ilandbringe smaa Fisk.

Vi vil nu gaa over til at betragte Fangsten af Rødspætter i Graadyb, over hvilken der forefindes en Statistik for en længere Aarrække. Der fanges her saa godt som aldrig store eller middelstore Rødspætter, men kun Smaafisk. Her har Sorteringen af Fisken, i alt Fald siden Sæsonen 1906—08 ikke været meget uensartet, idet Hovedmassen af de ilandbragte Fisk stadig har haft en Størrelse mellem 22 og 27 cm Totallængde. — Mindstemaalet for Ilandbringelse (og Salg til Udlandet) var i Sæsonerne 1907—08 til 1913—14 ca. 21 cm og i Sæsonerne efter 1914—15 22 à 22.5 cm. Foruden af Mindstemaalet paavirkes Sorteringen vel nok noget af Salgsprisen, idet Fiskerne er tilbøjelige til at ilandbringe forholdsvis mange Smaafisk, naar Prisen er høj.

Fangsten af Rødspætter i Graadyb foregaar fra smaa Baade, og som Fangstredskab benyttes almindeligvis en lille Bomtravl med en ca. $3^1/_2$ Meter lang Bom. Baadenes Fiskeevne er gennemsnitlig tiltaget i Aarenes Løb. Indtil 1902 førtes Baadene frem af Tidevandsstrømmene, men fra Efteraaret 1902 begyndte man at anvende Motorkraft ved Fiskeriet. I Begyndelsen anvendte man kun smaa Motorer paa ca. $1^1/_2$ Hestes Kraft. Senere er man gaaet over til kraftigere Motorer af indtil 10 Hestes Kraft. I de senere Aar har man ogsaa foruden Bomtravlen nu og da benyttet Snurrevaadet ved Fiskeriet.

Det fremgaar af Tabel 3 (Side 11), at Udbyttet af Fiskeriet har været yderst vekslende fra Aar til andet, men forholdsvis ringe i de tre Sæsoner efter Krigens Slutning, baade naar man ser hen paa Totaludbyttet og Udbyttet pr. Fiskebaad. Denne Statistik afgiver saaledes heller ikke noget Holdepunkt for Antagelsen af Forekomsten af en større Mængde af unge Rødspætter efter Krigens Slutning end forud for denne, men forskellige Forhold bevirker, at Statistiken kun har en stærkt begrænset Værdi som Udtryk for Vekslingerne i Fiskemængden indenfor større Omraader af Rødspættens Opvækstgrunde.

Det Areal, paa hvilket Rødspættefiskeriet i Graadyb i Hovedsagen foregaar, er meget lille, kun ca. 10—15 Kvadrat Kilometer. Den store Hovedmasse af de Rødspætter, der forekommer i Graadyb i Efteraarstiden, er ikke opvokset der, men indvandret fra Grundene vest for Fanø og Skallingen, og det er sandsynligt, at den Mængde Rødspætter, der optræder i Graadyb, ikke i alle Aar giver en lige god Afspejling af Befolkningstætheden paa de ydre Grunde. Dertil kommer, at Fiskeriet i Graadyb i ikke ringe Grad har Karakter af et Lejlighedsfiskeri, og at de vanskelige Afsætningsforhold i de senere Aar har bidraget væsentlig til, at Fiskeriet er drevet med ringere Intensitet end tidligere. Det kan herved bemærkes, at den foreliggende Statistik ingen Oplysninger giver om, hvor længe hver enkelt Baad har deltaget i Fiskeriet. En Opgørelse af Fangstens Størrelse pr. Baad og pr. Fiskedag kan saaledes ikke foretages her.

Saa vidt de foretagne statistiske Undersøgelser over de danske Fiskeres Fangst paa Rødspættens Opvækstgrunde i den østlige Del af Nordsøen med Graadyb rækker, er de imidlertid i Overensstemmelse med en Opfattelse, der er almindelig blandt Esbjerg-Fiskerne, nemlig at Mængden af unge Rødspætter ikke var større i Aarene 1919 og 1920 end i de senere Aar forud for Krigen.

Fiskeforsøg med finmasket Skovltravl.

Paa Figurerne 7—10 (Side 12—15) er angivet Antallet af Rødspætter af 0-Gr. og I-Gr., fanget pr. Time paa de forskellige Stationer i Somrene 1920 og 1921.

For at sammenligne de nye Resultater med de tidligere har vi konstrueret Tabeller over Gennemsnitsfangsten pr. Time i de forskellige Aar og i de forskellige paa Figur 1 angivne Omraader. Vi vil her betragte Omraaderne 1—5, der er beliggende ved Jyllands Vestkyst mellem Sydspidsen af Fanø og Hanstholm:

Gennemsnitsfangst pr. Time af Individer af 0-Gr. i Area 1—5 ved Jyllands Vestkyst.

	Fangst pr. Time							Antal af Stationer						
Area.....	1	2	3	4	4a	5	1—5	1	2	3	4	4a	5	1—5
1921.....	64	93	17	128	..	229	105	7	9	7	6	.	7	36
1920.....	21	85	68	8	205	35	76	2	8	7	7	6	5	35
1913.....	..	..	4	6	48	21	21	..	..	2	10	7	5	24
1912.....	284	337	56	121	482	180	250	7	4	5	7	7	5	35
1911.....	13	8	8	21	34	88	28	7	7	5	8	6	6	39
1910.....	95	83	58	..	..	..	85	7	7	2	..	..	..	16
1909.....	105	128	25	..	..	..	94	7	12	7	..	..	..	26
1905.....	27	25	32	251	104	108	92	3	6	6	11	15	9	49

Disse Tal viser, at Fangsten af 0-Gr. pr. Time ikke var særlig høj i nogen af Aarene 1920 og 1921 sammenlignet med Fangsten i Perioden 1905—13. Fangsten i Aaret 1912 var derimod usædvanlig stor, og Fangsten i 1909 var ogsaa i de sydlige Omraader (1 og 2) større end normalt og større end i nogen af Aarene 1920 og 1921.

En Sammenligning af Fangsten af I-Gr. i forskellige Aar giver ogsaa som Resultat, at ingen af Aarene 1920 og 1921 udmærkede sig ved Forekomsten af særlig store Mængder af Ungfisk (se Side 15).

III. Undersøgelser i Skagerak og det nordlige Kattegat.

Rødspætten i Skagerak har samme Racepræg som Rødspætten i den nordlige og mellemste Del af Nordsøen, og det samme gælder Flertallet af Rødspætterne i det nordlige Kattegat. Forskellige Forhold taler for, at en væsentlig Del af Rødspætterne i Skagerak og det nordlige Kattegat stammer fra Rødspætter, der yngler i Nordsøen. Den jydske Strøm fører pelagiske Æg og Larver med sig fra Nordsøen til Skagerak og Kattegat, og det er blevet paavist ved Mærkningsforsøg, at der foregaar en betydelig Udveksling af Rødspætter baade mellem Nordsøen og Skagerak og mellem Skagerak og Kattegat. Endvidere er det blevet paavist ved Finnestraaletællinger, at der foregaar en stærk Indvandring af unge Rødspætter fra Skagerak til det nordlige Kattegat.

Det vil saaledes være af Interesse i Forbindelse med Undersøgelserne i den østlige Del af Nordsøen at foretage en Sammenligning mellem de unge Rødspætters Hyppighed i Aarene før og efter Krigen ogsaa for disse Farvande, skønt der ikke her i de senere Aar er iagttaget en lignende stærk Ophobning af store og gamle Rødspætter som i Nordsøen.

Om Udbyttet af Rødspættefiskeriet i Skagerak og Kattegat.

I Tabel 4 (Side 16) er der givet en Oversigt over Totaludbyttet af Rødspættefiskeriet i Skagerak plus Kattegat i Perioden 1885 til 1920.

Statistiken er for Danmarks Vedkommende udarbejdet efter Fiskeri-Beretningen og for Perioden 1885—1908 tillige efter Oplysninger om Rødspættens Vægt pr. Snes i de danske Kutteres Journaler.

Oversigten omfatter ikke det danske Kystfiskeri for Skagerak for Aarene 1885—1890, idet der kun for et enkelt Aar indenfor denne Periode findes tilfredsstillende statistiske Oplysninger om Fangsten. I det paagældende Aar (1887) udgjorde Fangsten ved Kystfiskeriet ca. 935 Tons. Efter Oplysninger i Fiskeritidende maa det antages, at Udbyttet i Aarene 1885 og 1889 har været langt større, medens det i 1890 sandsynligvis har været mindre.

Statistiken over Udbyttet af det svenske Fiskeri kan kun føres tilbage til 1893.

Statistiken over Fangsten af Rødspætter fra tysk Side i Skagerak og Kattegat kan kun føres tilbage til 1903. Fangsten fra Tyskland har ingen Betydning før ved Aaret 1897, da man begyndte at anvende Damptravlere ved Fiskeriet.

Det aarlige Gennemsnitsudbytte for Aarene 1885—1920 er efter Tabel 4 ca. 5169 Tons. Inddeler man denne Aarrække i 6-Aars Perioder, faas følgende Gennemsnitsudbytte pr. Aar for hver af disse Perioder:

Periode	Aarlig Gennemsnits-fangst i Tons	Procent af Fangsten i 1885—90	Periode	Aarlig Gennemsnits-fangst i Tons	Procent af Fangsten i 1885—90
1885—1890	6222	100.0	1903—1908	5293	85.1
1891—1896	5613	90.2	1909—1914	4692	75.4
1897—1902	5430	87.3	1915—1920	3767	60.5

Det ses her, at Nedgangen i Gennemsnitsudbyttet er meget stærk. Den er endda stærkere, end man faar Indtryk af gennem Oversigten, da Udbyttet for de tre første Perioder og særlig for Perioden 1885—1890, som ovenfor omtalt, er ufuldstændig opgivet.

Det lave Udbytte i Aarene 1916—18 kan let forklares som en Virkning af Indskrænkningen i Fiskeriet under Krigen. Men det lave Udbytte i 1919 og særlig i 1920 er paafaldende, da Fiskeriet dog efter Krigens Slutning er genoptaget med ret stor Kraft, og da Priserne paa Fisken i disse Aar har været høje.

At Nedgangen i Udbyttet i det mindste delvis skyldes en Formindskelse i Bestanden af store og gamle Fisk, kan der næppe være Tvivl om. Det fremgaar af Uddrag af de danske Kutteres Journaler og forskellige andre Kilder, at der i Firserne i forrige Aarhundrede blev ilandbragt talrige store Rødspætter fra Skagerak, og at der indtraadte en gradvis Formindskelse i Gennemsnitsstørrelsen af de ilandbragte Fisk indtil Midten af Halvfemserne (Johansen l. c. 1910). Ligeledes har man iagttaget, at Antallet af gamle og kønsmodne Rødspætter er aftaget stærkt i Fangsterne fra Kattegat gennem en længere Aarrække helt op til Krigens Begyndelse.

Det Spørgsmaal melder sig nu, om Nedgangen i Udbyttet alene skyldes en Nedgang i Antallet af de gamle og kønsmodne Fisk, eller om der ogsaa har kunnet iagttages en Nedgang i Mængden af de unge Rødspætter.

For at bringe nærmere Oplysninger om dette Spørgsmaal vil vi betragte Rødspættefangsten i Skagerak og det nordvestlige Kattegat i en Aarrække.

Siden Midten af Halvfemserne er der ikke fra Skagerak eller det nordvestlige Kattegat ilandbragt større Mængder af gamle kønsmodne Rødspætter. Den store Hovedmasse af de Rødspætter, der i Aarene 1895—1920 er ilandbragt fra disse Farvande, er unge umodne Rødspætter eller Fisk, der nærmer sig Modenheden for første Gang. Saavidt man kan dømme efter de foretagne Aldersanalyser fra Perioden 1905—1922, har Flertallet af de ilandbragte Individer en Alder af 2—6 Aar.

I Tabel 5 (Side 17) er der givet en Oversigt over Udbyttet i Tons af det danske og det tyske Rødspættefiskeri i Skagerak i Perioden 1895—1920. Tabellen omfatter ikke Udbyttet af Baadfiskeriet fra Skagen i Skagerak, idet dette kun kan opgøres for Aarene fra 1909 og fremefter. (Udbyttet af det samlede Baadfiskeri fra Skagen, saavel i Kattegat som i Skagerak, er opført i Tabel 6).

Det fremgaar af Tabel 5, at der har været en stærk Nedgang i Udbyttet af Fiskeriet i Skagerak i den anførte Periode.

Af Tabel 6 (Side 18) faar man ligesom af Tabel 5 et Indtryk af en fremtrædende Nedgang i Udbyttet af Fiskeriet. For Perioden 1909—20 iagttager vi en ret jævn Nedgang i Udbyttet i Skagerak, men store Svingninger i Udbyttet i Kattegat. Maksimum i Udbyttet naas i Omraadet omkring Skagen i Aaret 1898. Fiskeriet, der foregaar fra smaa Baade i Nærheden af Kysten, generedes ikke væsentlig ved Krigsforanstaltningerne, og Nedgangen i Udbyttet er her fortsat indtil de seneste Aar. —

Nogle foretagne Aldersbestemmelser af Rødspætter fra Omraadet omkring Skagen i Foraaret 1922 viser, at Rødspætten her har haft en meget hurtig Vækst (Tabel 9 og Tabel 10 Side 19—20). Dette Forhold peger ogsaa hen paa, at Bestanden af Ungfisk for Tiden ikke er særlig stor i dette Omraade.

Tabel 7 (Side 18) omfatter Udbyttet af Rødspættefiskeriet fra de mindre Fiskepladser ved Aalbækbugten samt Udbyttet af Skagensbaadenes Fangst i Kattegat. Fangsten fra disse Pladser foregaar paa de unge Rødspætters Opvækstgrunde i Aalbæk Bugt og Hertha's Flak. Hovedmassen af de herfra ilandbragte Individer har en Længde mellem 24 og 33 cm og tilhører II-Gr. og III-Gr.

Det fremgaar af Tabellen, at Udbyttet af Fiskeriet har været meget vekslende. I 1914 og 1915 var det usædvanligt stort. Udbyttet i 1919 og 1920 var under Middel for den hele Aarrække 1909—1920.

Der er ingen Tvivl om, at den Intensitet, hvormed Rødspættefiskeriet er drevet i Skagerak og det nordvestlige Kattegat, i det hele er tiltaget i Perioden fra 1895—1914. De statistiske Oplysninger taler saaledes for, at der i den nævnte Periode har været en Aftagen i Bestanden af unge salgsbare Rødspætter i Skagerak. I det nordvestlige Kattegat har der været meget store Svingninger i Udbyttet, og det kan ikke afgøres, om der her har været en almindelig Tendens til en Nedgang i Udbyttet eller ikke.

I Kattegat som Helhed er Bestanden af gamle kønsmodne Rødspætter i Tidens Løb blevet stærkt reduceret. Samtidig hermed er Væksten tiltaget i de Omraader, der fortrinsvis befolkedes af de gamle Fisk. I en Aarrække har Rødspættefiskeriet i Kattegat aldeles overvejende været baseret paa ret unge Rødspætter i Alderen fra ca. 2 til ca. 7 Aar, hvoriblandt der dog findes mange flere kønsmodne Individer end i Skagerak-Bestanden. Betragter man Statistiken over Fiskeriet for Perioden 1909—20 (Tabel 8), vil det ses, at Nedgangen i Udbyttet under Krigen ikke var paafaldende stor, men Udbyttet i 1919 og 1920 har heller ikke været stort i Forhold til Udbyttet i Perioden 1909—14. I 1920 har Udbyttet endogsaa været paafaldende ringe, til Trods for, at Fisken har opnaaet høje Priser. Der synes i Kattegat hverken at være fremkommet en betydelig Bestand af ældre Rødspætter eller en betydelig Bestand af unge Rødspætter som Følge af Indskrænkningerne i Fiskeriet under Krigen.

Til Statistiken over Rødspættefiskeriet i Kattegat maa bemærkes, at det anførte Udbytte for Sveriges Vedkommende ogsaa omfatter Fiskeriet i Skagerak, idet Udbyttet fra disse Farvande ikke har kunnet holdes ude fra hinanden.

Fiskeforsøg med finmasket Skovltravl i Skagerak og det nordlige Kattegat.

Resultaterne af Fiskeforsøgene med finmasket Skovltravl i Skagerak og Kattegat i Aarene 1920 og 1921 er opført paa Figurerne 7—10 og for Skagerak og det nordvestlige Kattegat sammenstillede i nedenstaaende Oversigt til Sammenligning med tidligere Forsøg. (Om Beliggenheden af de forskellige Area se Fig. 1 Side 4).

Gennemsnitsfangst af Individer af Rødspættens 0-Gr. pr. Time i Skagerak og det nordlige Kattegat.

	Fangst pr. Time						Antal af Stationer					
Area	**6**	**7**	**8**	**9**	**10**	**6—10**	**6**	**7**	**8**	**9**	**10**	**6—10**
1921	144	218	194	87	255	181	11	5	7	4	7	34
1920	43	18	39	33	76	44	19	6	6	3	8	42
1913	121	42	40	16	12	61	12	6	6	4	6	34
1912	414	388	281	112	54	289	16	6	6	5	7	40
1911	95	79	172	136	375	151	14	6	7	4	5	36
1910	..	44	83	35	38	55	..	2	6	4	4	15
1909	21	16	33	19	32	25	2	7	6	4	6	25
1907	..	..	64	18	110	64	..	..	5	2	2	9
1906	..	67	33	43	18	43	..	5	8	6	2	21
1905	203	106	12	44	9	106	17	5	11	3	5	41

Det vil ses, at Fangsten pr. Time var mindre end normalt i 1920, men større end normalt i 1921. I 1912 var Fangsten dog endnu større end i 1921. Som foran anført var der ogsaa i 1912 en særlig stor Fangst ved Forsøgene paa Strækningen fra Fanø til Hanstholm. Den store Fangst i 1911 er overvejende et baltisk Fænomen. Det var særlig fremtrædende i det sydlige Kattegat og Belterne (A. C. Johansen l. c. 1913).

For I-Gruppens Vedkommende iagttages den største Fangst i 1913: Aaret efter den store Fangst af 0-Gr. (se Side 21).

IV. Om Værdien af de systematiske Fiskeforsøg som et Middel til at paavise Variationer i Hyppigheden af de unge Rødspætter.

Det Spørgsmaal rejser sig naturligt, om man har nogen Beviser for, at de foretagne systematiske Fiskeforsøg med finmasket Skovltravl har nogen virkelig Betydning ved en Undersøgelse af Variationerne i Rødspætteyngelens Hyppighed fra Aar til andet. En Række Faktorer bidrager til, at man paa Forhaand nærer en vis Skepsis overfor Undersøgelser af denne Art. Af saadanne Faktorer kan fremhæves følgende:

1) Befolkningen af Rødspættens 0-Gr. er ikke jævnt fordelt selv indenfor snævert begrænsede Omraader. Befolkningstætheden varierer stærkt fra Sted til Sted, og smaa Forskelligheder f. Eks. med Hensyn til Dybden eller Bundarten, kan ledsages af store Forskelligheder i Befolkningstætheden.
2) Forskellige Travle har ikke samme Fiskeevne, selv om Travlenes Dimensioner er de samme. Ganske smaa Forskelligheder i Konstruktionen eller i Underligets Vægt etc. kan rimeligvis fremkalde betydelige Forskelligheder med Hensyn til Fiskeevnen.
3) Den Hastighed, hvormed Travlen trækkes hen over Bunden, har Indflydelse paa Fangstens Størrelse, og den maa varieres en Del af Hensyn til Strømmens Retning og Styrke. I visse Aar kan Hastigheden være valgt mere fordelagtig end i andre Aar.
4) Vejrforholdene har en betydelig Indflydelse paa Fangstens Størrelse. Er Søen urolig, paavirkes Fangsten med et saa let Redskab som finmasket Skovltravl stærkt heraf.
5) Vandets Gennemsigtighed har utvivlsomt ogsaa en Indflydelse paa Fangstens Størrelse. I meget klart Vand kan Rødspætterne lettere flygte bort fra Fangstredskabet end i mindre klart Vand.

Til Trods for alle disse forstyrrende Faktorers Indvirkning, foreligger der dog vigtige Beviser for, at der maa tillægges de foretagne Fiskeforsøg en væsentlig Betydning. Der er nemlig paa forskellige Steder iagttaget Svingninger i Udbyttet af det praktiske Fiskeri, der øjensynlig svarer til de iagttagne Svingninger i Fangsten af Yngelen ved de systematiske Fiskeforsøg. Særlig instruktiv er saaledes en Sammenligning mellem Fangsterne af Rødspættens 0-Gr. og Statistiken over Udbyttet af Rødspættefiskeriet i Graadyb (Tabel 3). Der fanges her, som ovenfor nævnt, aldeles overvejende Smaafisk af 21—27 cm Længde, som overvejende tilhører III Gr. eller IV Gr.[1] Statistiken over Udbyttet viser nu, at der i Perioden 1898—1920 har været to meget stærkt markerede Maksima, baade naar man betragter Totaludbyttet og Udbyttet pr. Fiskebaad for en Sæson eller i den Maaned, hvor Udbyttet har været størst. Disse Maksima falder i Sæsonerne 1912—13, 1913—14 og 1916—17. Det første Maksimum, der omfatter 2 Sæsoner, falder saaledes henholdsvis 3 og 4 Aar efter den relativt store Fangst af Rødspættens 0-Gr. i Area 1 og 2 i 1909 og henholdsvis 2 og 3 Aar efter den relativt store Fangst af Rødspættens I-Gr. sammesteds i 1910. Det stærkt udprægede Maksimum i Udbyttet af det praktiske Fiskeri i 1916—17 falder 4 Aar efter det ligesaa stærkt udprægede Maksimum i Fangsten af Rødspættens 0-Gr. i 1912 (se Side 11).

Som foran anført fangedes der ved Kysterne af Skagerak og det nordlige Kattegat forholdsvis megen Yngel af 0-Gr. i 1912 og Aaret efter forholdsvis megen Yngel af I-Gr. (se Side 20—21). Tabel 7 viser, at Udbyttet af Baadfiskeriet i Aalbækbugten og paa Herthas Flak var usædvanlig højt i 1914 og 1915. Da flere Aldersanalyser viser, at Flertallet af de Rødspætter, der ilandbringes fra disse Opvækstgrunde, tilhører II-Gr. og III-Gr.[1], kan der næppe være Tvivl om, at det er den store Yngelmængde af Aargangen 1912, der er Aarsagen til det store Udbytte af Fiskeriet i 1914 og 1915.

Endnu kan der henpeges paa, at i det mellemste og sydlige Kattegat fangedes der usædvanlig store Mængder af 0-Gr. i 1911, medens, som anført, Aargangen 1912 var særlig rigt repræsenteret i det nordlige Kattegat. Det er i denne Sammenhæng af Betydning at lægge Mærke til, at Udbyttet af Rødspættefiskeriet i Kattegat var relativt stort i Aarene 1914 og 1915 til Trods for, at Fiskeriet i disse Aar i nogen Grad

[1] Medd. Kommissionen for Havundersøgelser, Ser. Fiskeri, Bd. III, No. 4, 1908 & No. 8, 1910.

blev hæmmet af Krigsforanstaltningerne (se Tabel 8). Individerne af II-Gr., III-Gr. og IV-Gr. udgør nu til Dags en meget væsentlig Part af de Rødspætter, der ilandbringes fra Kattegat.

Med Hensyn til de andre foreliggende Beviser for de systematiske Fiskeforsøgs Betydning for en Paavisning af Variationen i Rødspættens Hyppighed i forskellige Aar henvises til en tidligere Afhandling af Forfatteren »On the Variation in Frequency of Young Plaice in Danish Waters in 1902—07«.

V. Slutningsbemærkninger om Resultaterne af de foretagne Undersøgelser.

Vi har i de foregaaende Kapitler set, at de foretagne Undersøgelser i Nordsøen og Skagerak ikke peger i Retning af, at der efter Verdenskrigens Slutning skulde være større Mængder af unge Rødspætter end i de senere Aar før Krigens Begyndelse. Ved Fiskeforsøgene med finmasket Skovltravl har vi fundet, at Aarene 1920 og 1921 ikke udmærker sig hverken ved særlig store Mængder eller særlig ringe Mængder af Yngel ved Jyllands vestlige Kyster. Det første af disse Aar maa nærmest betegnes som noget under Middel, det andet som noget over Middel med Hensyn til Yngelmængden. Ved Undersøgelse af de danske Kutteres Fangst pr. Fiskedag paa Opvækstgrundene for de unge Rødspætter i den østlige Del af Nordsøen har vi fundet, at Gennemsnitsfangsten i 1919 vel var større i Vægt, men omfattede færre af de mindre Individer end Gennemsnitsfangsterne i Aarene 1909—1913.

Den stærke Tiltagen i Bestanden af ynglende Rødspætter i Nordsøen, der er fremkommet som Følge af Indskrænkningen i Fiskeriet under Krigen, har saaledes ikke givet sig noget synligt Udslag i Form af større Mængder af Yngel eller Ungfisk ved de danske Kyster. Den Mængde af Yngel, der kommer til Udvikling og vokser op i et givet Farvand, er utvivlsomt i nogen Grad afhængig af Størrelsen af Bestanden af ynglende Fisk, men de iagttagne store Vekslinger i Yngelmængden fra Aar til andet skyldes aabenbart i Hovedsagen andre Aarsager. Disse Aarsager er endnu i Hovedsagen ukendte, men for Nordsøens Vedkommende kan de næppe skyldes Vekslinger i Temperaturen eller i Vandets Indhold af Salte eller Ilt. For disse Faktorers Vedkommende kommer man ikke i Nordsøen ned til et for Æggene eller Larverne eller de unge Bundstadier eller Moderfisken katastrofalt Minimum. Hovedaarsagen til de aarlige Vekslinger i Yngelmængden er snarere at søge enten i Mangelen paa passende Føde eller i Tilstedeværelsen af for mange Fjender under et eller andet af Rødspættens Udviklingstrin. I denne sidste Retning kan der henpeges paa, at samtidig med, at Bestanden af store og middelstore Rødspætter er vokset stærkt som Følge af Indskrænkningen i Fiskeriet under Krigen, er Bestanden af en af de unge Rødspætters værste Fjender, nemlig Torsken, sandsynligvis ogsaa tiltaget stærkt.

Den almindelige Fangst-Statistik for Nordsøens Vedkommende giver Vidnesbyrd om en stærk Aftagen af Bestanden af store og gamle Rødspætter i Perioden fra 1902—1914 men giver intet Holdepunkt for Antagelsen af en Nedgang i Bestanden af unge, salgsbare Rødspætter. Statistiken for Skagerak giver Vidnesbyrd om en stærk Aftagen af Bestanden af store og gamle Fisk i Perioden fra 1885—1895, og den peger tillige i Retning af, at der ved Siden af store Fluktuationer fra Aar til andet er sket en gennemsnitlig Formindskelse af Bestanden af unge salgsbare Fisk, siden Midten af Halvfemserne.

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